NATURAL RESOURCES AND THE DEVELOPMENT OF LAKE VICTORIA BASIN OF KENYA

Occasional Paper No. 34

Edited By C. O. Okidi

INSTITUTE FOR DEVELOPMENT STUDIES
UNIVERSITY OF NAIROBI
P.O. BOX 30197
NAIROBI, KENYA

Papers prepared and presented for a series of workshops on the development of the Lake Basin held between March and July 1979 at the Institute for Development Studies, University of Nairobi.

JULY 1979

INTRODUCTION

The papers in this volume were prepared for a multidisciplinary Workshop conceived and organized at the Institute for Development Studies, University of Nairobi. The purpose of the exercise was to stimulate academic discussion and policy-oriented analysis on a regional development plan which also had a great deal of national significance: The Lake Victoria Basin Development.

Background.

Drainage basin development as an approach to regional planning is an attractive concept because it focusses on the management of the most important requirement for development: Water. This basic natural resource tends to influence the quality, distribution and abundance of the other natural resources especially crops, forestry and soil. But even more important is the fact that water is a basic requirement for improvement and maintenance of human health which, in turn, is part of, and a pre-requisite to, development and public participation in development activities. At this general level we can emphasize, too, that a drainage basin is an ecological unit where natural resources interact and influence one another. Development can therefore be considered planned within a "natural unit".

It is largely for these reasons that the people at the Kisumu rally on the 16th December 1978 applauded President Moi when he directed the Vice President and Minister of Finance and the Minister of Planning and Community Affairs to establish a Lake Victoria Basin Authority to spearhead development work in the Lake region as well as to harness the waters of all the rivers flowing into Lake Victoria to prevent dangerous flooding and put the waters to good use.

A lake basin may be defined as its catchment area, or that entire area whose drainage system contributes water towards a common terminus. In the present case the common terminus is the Lake Victoria itself and the idea of development focuses on various uses to which its water can be put to enhance development. But the considerations of area to be developed is not confined to the lowlands or plains immediately surrounding the Lake. Rather, it applies to the entire area of the drainage. This is the idea which facilitates management of the water in its various quantities and quality from its very sources. It is the idea which underlie what the

directive on the Authority with respect to management of the waters of the rivers to prevent floods through damming and storage for beneficial uses which may include irrigation, during times of drought, and harnessing the water for hydroelectric power generation. In effect, the Authority to be established might concentrate its development operation largely within Nyanza and Western Provinces, as the development area, but with clear jurisdiction to manage water outwards as dictated by the patterns of such drainage systems as rivers Sio, Nzoia, Yala, Nyando, Miriu, Awach, Kuja and Mara; among others, as may be hydrologically determined. This would mean some projects of the Authority being also in some western parts of the Rift Valley Province, as the upper reaches of the drainage system.

This element of hydrological unity requires that our discussion should consider aspects of Lake Victoria which are not Kenyan. The Lake has a total area of about 68,800 square kilometers; but only about 10% of that area is in Kenyan territory. Tanzania has about 50% while Uganda has about 40%.

The ninety percent area of the Lake not within Kenya is of interest to considerations of the Authority to be established for several reasons. For instance, the resources of the Lake such as fish will not obey any of the territorial boundaries. They roam the Lake according to their own biology; therefore, plan for conservation and exploitation of the resources would, per force, take into account the development in the entire lake. Similarly, pollution, as a danger to aquatic resources will not repsect the boundaries; questions of treatment and discharge of the municipal and industrial effluents into the Lake would need to be dealt with on a lake-wide basis. Yet another critical issue on the hydrological unit is that control of intake or outlet of water of the Lake may have consequences in other parts of the Lake. This is the question that has been raised with regard to control of sluices at Owen Falls dam at Jinja. It has been argued in the East African Legislative Assembly and in the Kenya Parliament that the control of sluices has been responsible for backwater effect, rising level of the Lake and resultant flooding which, on the Kenyan part of the Lake, resulted in the submergence of the pier facilities at Kisumu, Kendu Bay and Homa Bay in 1960s; flooding of large tracts of land around the Nyanza or Winam Gulf and the increased mosquito breeding in the area; destruction of breeding grounds of some species of fish; and other adverse physical and environmental consequences. It may also be suggested

that the Authority in Kenya would not be indifferent to increased use of the Lake water for irrigation - beside municipal and domestic uses, in Central Tanzania. Tanzania, Rwanda and Burundi have also decided to use the Kagera waters for irrigation and general development of the Kagera basin.

The point here is that the Authority in Kenya would need to arrange a forum or system for consultation with the relevant agencies of Tanzania and Uganda on approaches to development of the basin that are for their mutual benefits or, at least, where actions by one state take into account the interests of others. The establishment of such a system of consultation is clearly very necessary if one considers the various uses to which the waters of this second largest freshwater lake in the world would be put. The idea of consultation does not meant that one country seeks permission; it simply means that one country alerts others of its intentions so that appropriate measures, and mutual agreement can be designed and implemented to mitigate possible adverse consequences. Every country might need the system at one time or another.

So we suggest that the establishment of the Authority and its operations might be the first step in efforts to deal with the Lake Victoria basin as a hydrological unit and to ensure balanced management of its water resources. The papers in this collection focus discussions on the prospective work of the Kenyan part of the Lake Victoria Basin Development Authority.

The Workshop Concept

The purpose of the papers was to stimulate discussions on the development role of the Authority, and hopefully to contribute towards broader understanding of the task as proposed by the President. The Workshop sought to examine the resources available in the Lake Victoria Basin and guidelines for development of the area through management and utilization of those resources. The selected topics related to the resources that are associated with the Lake Victoria Basin and individuals with known competence were asked to prepare papers on the topics and to present such papers for discussions.

The Workshop concept developed for this exercise entailed discussion of the papers at two stages. The first stage, involved presentation of individual papers for a seminar series at the Institute for Development Studies.

The discussions averaged about one-and-a half hours duration, each, and were thematic but with entirely open participation so that the authors could take advantage of the questions and comments on the merits of the paper. Invitations to these seminars were entirely open to all persons interested in the subject matter of the paper or on the Lake Victoria Basin Development. An average of thirty people attended. This series may properly be called pre-workshop seminars. At the end of every session the authors were requested to improve on the papers accordingly. Out of the twenty-one papers that were invited nineteen were presented and discussed from March to July 1979.

The second stage of the Workshop was scheduled to take place at Kisumu in form of a five days exercise from 30th July to 3rd August, 1979. The intention here was that the thirty-seven technical persons invited would compile a set of recommendations and guidelines for planning the development of the basin area using the resources discussed in the papers.

The participants at this session were the authors of the papers and a number of technical officers from Government departments only. Unfortunately, the Kisumu session was started but not completed; someone did not like the exercise and ordered it to halt!

Goals of the Workshop

The Workshop was designed to perform a research service by giving a synoptic expose of the information available on resources of the Lake Victoria Basin. Such information may, indeed be available but is scattered literature under collection of various governmental agencies and academic libraries. This is the first collection and is a point of departure for all future references. The compilation benefited from the discussions and appraisal by participants from various backgrounds. Therefore, the complete set should be useful to researchers and policy-makers alike.

Secondly, the volume contains several recommendations and guidelines for the working of the Authority to be established. The guidelines suggest strategies for management of the resources by the Authority. The focus of these recommendations would be on the President's directive that the Authority should spearhead development within the Lake Victoria Basin.

Finally, the papers in this volume propose some key areas of further discussion or research and to recommend how in its plan of collaborative research the Institute for Development Studies can work with the other

Departments of the University and the Government's ministries in an effort to promote understanding of Lake Victoria Basin development and similar projects in Kenya especially in the area of natural resources management. Our view is that beside any contribution which the Workshop might have made to policy in this instance the Institute will have performed a significant role in generating research information in one of its areas of research priority - natural resources management. There should probably be efforts of similar character to generate basic information on other areas of the country.

Outline of Topics

The range of topics that could have been discussed for this Workshop is as wide as the very field of development studies. We rather arbitrarily chose some of the resource areas simply to confine the workshop within manageable parameter. But even then, each of the subjects that were chosen would have been discussed to full-book-size publications. This meant then that the authors were allowed broad discretions as to how much they could say on the topics to fulfill the requirements of the Workshop. In ultimate analysis we settled for the expositions that would provide points of departure and packages of broad recommendations.

The papers were grouped in five broad categories that took the foregoing points into account. The categories were: (1) Human Resources, to include discussions of population and its changing patterns; health problems and services; education needs and services; and strategies for elimination of poverty through gainful employment. The underlying assumption for the section is first, that development is planned for the human beings and the same people effect development. Secondly, that improved health services is an indicator of development; at the same time, only healthy people can actively participate in development programmes. Similarly, improved educational infrastructure is an indicator of development; at the same time education is to be geared towards development of manpower needed for enhancement of development process. (2) Water and Mineral Resources, to include surface and ground water of the basin and its potential uses as well as quality and its control; and the mineral resources. (3) Land and its uses, under which are discussed: Soils and ecology of the basin area, agricultural products - including crops and livestock, and land tenure. (4) Other Natural Resources, fisheries, game and forestry and their possible contribution to

development. (5) Institutional framework for the authority and its purposes. Under this section are papers on the concept of integrated regional development and the institutional framework which would enable the Authority to meet its goals.

It should be pointed out here that the contents of the papers are the responsibility of the authors who made the contributions in their individual capacities.

Recommendations and Guidelines

The recommendations contained in this volume correspond to the topic areas outlined above. The original plan was that such recommendations would be debated by the participants at the ill-fated Kisumu session. But that effort having been halted by a government fiat, some five persons were formed into a study group to complete the task. The five people were G.M. Ruigu, O.P. Alila, S.B.O. Gutto, J.G.C. Amolo and the present writer. J.E.O. Odada worked with the group part of the way. Most of the ideas contained therein were gleaned from the papers and the seminar discussions, while other ideas are derived from the intimate knowledge the group have of the basin area.

Acknowlegements

My first appreciation goes to those who prepared papers for the Workshop. These individuals with full-time job responsibilities took up the challenge of preparing scholarly papers which required a great deal of time and intellectual concentration. In most cases the time allowed for the task was relatively very short. Within four months we had nineteen specialized papers written discussed and, in most cases, revised. Second, as the organizer I thank the four individuals who worked on the recommendations and guidelines. The task was arduous and demanding of intellectual concentration and time. If these recommendations do not contain what the executives of the Authority would like to do then at least they helped delineate the opposite of what the Authority will do. Third, I should commend all those who took time to attend the seminar series, sometimes up to three seminars per week. Most of the participants contributed in form of questions and comments which enriched the papers and the final recommendations. Because of the multidisciplinary nature of the seminar series almost every one who attended learned something new. The purposes of research and education which

we set out with were, in our view, achieved. Fourth, I owe special gratitude to those from the Government departments and from the University who, in their good faith and zeal, agreed to go to the Kisumu Workshop. Fifth, I thank the Ford Foundation who extended financial donation toward the cost of the Kisumu Workshop. Sixth, a special mention should be made of the IDS staff in the Machine Room and Typing Pool who worked hard and over long hours to prepare the papers in the present volume. Finally, I owe special gratitude to Mrs. Justina Muchura the IDS Publications Editor who, with patience and zeal prepared the papers into fully readable form.

C.O. Okidi
5th October 1979.

POPULATION AND ITS IMPLICATIONS FOR RESOURCE DEVELOPMENT IN THE LAKE VICTORIA BASIN

By

John O. Oucho
Population Studies and Research Institute
University of Nairobi

INTRODUCTION

Despite its diversified physical and human endowments the Lake Victoria Basin has for a long time remained an under-developed region in Kenya. The proclamation in December 1978 of the Lake Basin Development Authority (L.B.D.A.) naturally evoked political emotions among the population in the region and ushered in an era of development planning whose complexity as well as significance demands careful analysis within the matrix of planned regional development. Incidentally, the proclamation was made at the most populous political rally in Kisumu, the demographic, commercial, industrial and, prior to independence, the administrative focus of Western Kenya. The proposed development programme brings into fruition an idea that has been mooted for many decades throughout the shaping of development in Kenya.

As a prelude to this paper it is necessary to mention a few instances where the idea has evolved and certainly ones that planners in the lake basin may wish to investigate further. Fearn's analysis of the economic and social development of the defunct Nyanza Province, which at the time of his writing encompassed the present Nyanza and Western Provinces as well as Kericho district, echoed the salient economic, social and demographic capacities of the Lake Victoria Basin.[1] But like many studies, it remained an academic exercise whose ramifications in rural transformation were completely ignored. In the context of regional development the region has been identified as transcending administrative,

---

1. In several publications H. Fearn made incisive analysis of the potentialities of the Lake Basin. They include: "Population as a factor in Land Usage in Nyanza Province of Kenya Colony" East African Agricultural Journal, Vol. 20, No. 3, 1958, pp. 198-200; "Cotton Production in the Nyanza Province of Kenya Colony" 1908-1954, Empire Cotton Growing Review, Vol. 33, No. 2, 1956, pp. 1-14; and Oxford University Press (London, 1961).

ethnic and inter-territorial boundaries.[2] Again, this significant fact has been simply ignored. Delimitation of the lake basin on the basis of various indices underscores its cohesiveness as a resource - planning region. This fact has been explicitly considered by a group of German scholars who studied the basic features of planning in the hinterland of Kisumu town.[3] The demographic dimension of resource utilisation in the region has instigated investigative analysis by a wide spectrum of scholars, pioneered by Ominde's study of population land relationships.[4] Although these contributions have remained academic exercises, they have succeeded in keeping alive the debate of population and development. Since the attainment of independence in 1963, the Kenya Government has therefore emphasized regional physical development programme alongside national social-economic development by gauging regional planning against specified realities, not least demographic, in different parts of the country.[5] A striking feature of the regional physical development plans for Nyanza, Western and Rift Valley provinces is their defiance of administrative boundaries and therefore their overlap in terms of ecological, resource and demographic considerations. Thus regional development must of necessity be flexible enough so as to adjust readily to changes, anticipated or accidental, that may be required.

---

2. Fair, F.J.D "A Regional Approach to Economic Development of Kenya, South African Geographical Journal", Vol. 45, 1963, pp. 55-77.

3. Waller, P.P. Basic Features of Regional Planning in the Region of Kisumu, Kenya. Dentsches Institut fur Entiwicklungspolitik, Berlin, 1968.

4. The pioneering study by Ominde of the area, later expanded to incorporate other regions of Kenya has underscored the importance of population factor on land use. See Ominde, S.H. Land and Population in Western Districts of Nyanza Province, Kenya. Unpublished Ph.D. Thesis, University of London, 1963; and Land and Population Movements in Kenya. London: Heinemann, 1968.

5. Apart from the five-year development plans in Kenya the government has drawn regional physical development that results in their overlap. This responsibility has been co-ordinated by the Physical Planning Department in the Ministry of Lands and Settlement; it maps out a hierarchical pattern of development from urban, rural, market and local centres within every region.

This paper attempts a double-pronged exercise. On the one hand, it portrays the demographic background of the Lake Victoria Basin, placing greatest emphasis on demographic realities which regional planning and development of the area have to take cognizance of. On the other hand, it analyses basic demographic data that would have to be incorporated in this complex development programme. In both cases the cardinal point around which the paper pivots is the "water resource" whose uses and abuses may be respectively instrumental in or detrimental to development of the Lake Victoria Basin. Given the human capacity as well as agro-industrial potentialities of the region, water is, and will for a long time remain, the basic resource for and the driving force behind its development. Accordingly, the paper is structured to examine several closely interrelated phenomena: delimitation of the Lake Victoria Basin Development Authority on the basis of different indices; geographical background and resource base of the lake basin, and their scope for regional development; the demogrphic background with special emphasis on population size, population distribution and density; aspects of population structure both demographic and socio-economic terms; trends in population growth and re-distribution with special reference to net migration patterns; and placing demographic cards on the table of the L.B.D.A. itself in an attempt to feed demographic data into the development model.

DELIMITATION OF THE LAKE VICTORIA BASIN DEVELOPMENT AUTHORITY:

The Lake Victoria Basin includes the whole region in Western Kenya which focuses on Kisumu town by transportation and communication networks that connect the latter with its hinterland. It thus encompasses nine districts, namely, Kisumu, Siaya, Kisii and South Nyanza in Nyanza Province; Kakamega, Busia and Bungoma in Western Province; and Kericho and Nandi in Rift Valley Province. These nine administrative districts are inhabited by predominantly single ethnic groups: the Luo in Nyanza, the Luhya in Western and the Kalenjin in Rift Valley. Regional development will of necessity have to rectify sub-regional inequalities, while instituting projects that meet the taste of diverse socio-cultural entities in the area.

Drainage system delineates the boundaries of the Lake Victoria Basin. There are essentially two broad water catchment areas in the basin. To the north is the Lake Victoria North Catchment drained by Nzoia and Yala rivers with their sources, courses and mouths traversing the three provincial boundaries. In the south is another catchment drained by Nyando, Sondu, Kuja and Mara rivers, also with the longitudinal profile covering the three

neighbouring provinces. The drainage system, dependent upon heavy and reliable rainfall and featuring meanders, waterfalls and rapids, augurs well for multiple uses of water in the region: for domestic, agricultural and industrial purposes. These rivers pour their waters into Lake Victoria, the largest fresh-water lake in the world, and therefore a most peculiar resource for regional, national and international broadly based development. Lake Victoria basin thus constitutes one of the most interesting and distinctive morphologic macro-regions of East Africa. Most of the rivers draining the basin meander in broad shallow valleys but whose bends have now been re-excavated by process of physiographic rejuvenation, thus creating gorges and waterfalls which would be harnessed into multi-purpose dams for domestic water consumption- irrigation, hydro-electricity and fishing for the whole region and beyond.[6] Yet the problem in the basin is not really lack of diversified use of water but its disruptive effects in terms of frequent floods in the lowlands.

ENVIRONMENTAL BACKGROUND

Generally, both geographical and demographic boundaries of the Lake Victoria Basin coincide. The basin embraces the plateau country sloping westwards from the highlands that border the Central Rift geographical division. In the plateau itself there are two micro-relief regions north and south of Winam gulf, the sub-division being made by the Nyanza Rift Valley running on east-west line trend. The whole lies at an altitude of between 900 and 1800 metres above sea level.

Climate is regulated by these micro-relief differences. On the whole, the Lake Basin is a hot wet area for most part of the year. Temperatures vary between 27°C in the hottest month and 18°C in the coldest month, usually January and July respectively. Rainfall pattern marks distinctive contrasts. Mean annual rainfall varies from over 178 millimetres in the higher ground to 760 millimetres on the lowland.

---

6. A study of the drainage system demonstrates the capacity of the Lake Victoria Basin for domestic water supplies, hydro-electricity, fishing, irrigation, etc. See Ouma, J.B. Evolution of Meander Traits in the Basin of Lake Victoria, in S.H. Ominde (ed.) Studies in East African Geography and Development. London: Heinemann, 1971, pp. 29-40.

These contrasts are also evident in land potential differential in the area. Most of the high potential land is found in the better watered areas either underlain by soils derived from recent volcanics or volcanics from Pre Cambrian period. The fertile Kisii and Kericho highlands as well as the slopes of Mt. Elgon and isolated parts in Kakamega district fall in this category. Along the lower lake shores the Black Cotton soils are equally fertile but their productivity is precluded by frequent flooding and drought. The case of Kano Plains, Bunyala Lowlands testifies to this.

Ecological zoning of Kenya shows that the basin is an immense ecological region with diverse micro-biogeographical endowments heavily dependent upon water as the major resource. The economy of the region has evolved against the background of three broad ecological regions. From the Lake shore moving to higher and better-watered areas ecological succession comprises the Low Rainfall Lake Shore savanna covering much of Kisumu, Siaya, South Nyanza and Busia districts; the High Rainfall savannah Zone (Acacia Combretum Zone) lying between the first and second ecological zones cover Kakamega, Bungoma, Kisii, Kericho and Nandi districts, predominance of biogeographical type being determined by micro-ecological conditions. Translated in agricultural activity the succession involves cultivation of cotton, sugarcane, bananas, cereals (especially maize and sorghum) and in the higher parts coffee, tea, pyrethrum as well as livestock farming.

Resource base is modest but remains inadequately exploited. Before World War II there was modest mining activity concentrated around Kakamega town, Macalder in South Nyanza and isolated patched in Siaya district. This resource has so far been exhausted, but current geological survey of the region is being intensified in an attempt to discover more minerals. Forestry has been and today promises to remain a most dependable resource; forests in Kakamega and Bungoma districts as well as the process of re-afforestation in amiable areas give much scope for utilisation of hard and soft woods for a variety of products. Wildlife meets still competition from different aspects of human activity including settlements, and thus has little promise in the future. Water therefore constitutes the most dependable an inexhaustible (provided due attention is given to the "hydrological cycle") resource in the lake basin. In the course of his speech in Kisumu, the President recognised the human resources of the Lake Victoria Basin, which he believed, as everybody elsewhere believes, is an asset to development of the region. Research is also being carried out in the lake to

orientate fishing to the distribution, migration as well as judicious exploitation of fish.

The lake remains the most dependable resource in the area. This may be considered in various contexts. In the first place, it is the largest fresh water lake in the world whose water can be used for domestic consumption and Irrigation of the neighbouring dry area. Already, attempts are being made to develop a network of piped water in the lowlands immediately bordering the lake. But there are yet a number of technical, administrative and socio-cultural problems to solve before the scheme can succeed in the area. The most disappointing experience is abundance of unused water during the wet season (usually the flooding period) and lack of it for most part of the year when no rainfall is received. This problem requires careful consideration if rational use of water has to be systematized. The lake also has a large stock of different types of fish. Yet fishing has remained one of the least modernised potential industries in the area because of perpetuation of traditional forms of fishing; overfishing certain well-known parts of the lake; lack of viable co-operative societies that would give fishermen a powerful bargaining position with their customers; poor transportation system between fishing villages and market centres; and a host of other socio-economic problems. This resource has the capacity for diversified industrial activities closely connected with it.

In demographic terms, the Lake Victoria Basin is a heavily settled region. Population distribution is generally influenced by rainfall distribution; relatively sparse along the lake shores where rainfall is low and erratic; moderate on higher parts of the plateau; and clustered in the highest areas with heavy rainfall throughout the year. Add to this, large chunks of the high, fertile rainiest areas have been alienated for commercial farming especially in tea and sugar plantation as well as mixed farming. Except for Nandi and Kericho districts the Lake Victoria Basin is an area of out-migration, whence population migrates into the two districts, commercial farming regions further afield and urban centres throughout the country. Urbanisation is still insignificant but, paradoxically, increasing rapidly; it is limited to administrative headquarters of all districts - Kisumu, Siaya, Homa Bay, Kisii, Kericho, Kapsabet, Kakamega and Bungoma. But market-towns have proliferated in farming areas to serve their immediate hinterlands. It is these urban centres that occupy the highest order within the urban hierarchy, and that organise regional physical development at various echelons of the hierarchy.

in Busia district demand proper water management with due regard to other riparian users of the drainage networks. Over the last decade population density in these districts must have increased considerably, given consistent increase of population within conscripted administrative units. Population census planned for August-September 1979 is therefore eagerly awaited since it will give more up-to-date demographic statistics to be used in the L.B.D.A. and may also influence projections that have been made on the basis of 1969 census.[8]

Assuming that district boundaries remain unchanged, population densities will increase considerably in the next decade. They would tend to be twice as high as in 1969, thereby aggravating man - land ratio which has reached a critical level in some areas in the Lake Basin. This problem poses considerable threat to development planning envisaged in the region unless substantial scientific and technological innovations are realised.

Urban-rural population distribution in the region explains the demographic share of the relatively more developed urban centres and the less developed rural areas. At the last census the lake basin had ten urban centres which among themselves shared a total population of about 72,000, barely 7.0 percent of the total urban population in the country. Kisumu town alone accounts for just over 3.0 percent of urban population in Kenya and 45 percent in the lake basin alone. Consistently high sex ratios for all urban centres demonstrates masculinity which is an important demographic feature of urban centres, the major net in-migration areas in the internal migration process. This feature in Table 2 contrasts sharply with that of out-migration rural areas which, as Table I reveals, have low sex ratios, evidence of preponderance of female population. As a result of this process of population re-location, rural economy has stagnated in the hands of conservative population who generally perpetuate longstanding traditional forms of economy and remain least receptive to innovations that could modernise the economy.

---

8. Analysis of the quality of agricultural land by the International Labour Organisation shows that lake basin has large chunks of land which can be cultivated only by certain scientifically and technologically viable techniques. Closer treatment of this may be found in Oucho, J.O. Population, Family Size, Nutrition Resource and Development: the Experience of Vihiga/ Hamisi S.R.D.P. Paper presented at the UNESCO sponsored seminar on Integrated Rural Development, 30th January - 10th February, 1978.

From the foregoing, it is evident that the Lake Victoria Basin Development Authority rests on a broad premise that gives it firm foundation for a strong development edifice. Against this backdrop may be considered the role of Kisumu town on which the L.B.D.A. focuses. Available infrastructure in the town augurs well for regional development providing it is consistently expanded to meet the challenges that arise from the exponential nature of growth and development.

DEMOGRAPHIC BACKGROUND

The Lake Victoria Basin constitutes the highest and most extensive population cluster in Kenya, two smaller concentrations being found in central and coastal Kenya. At the time of 1969 census it had a total population of 4.1 million distributed as shown in Table 1. Nearly 40 percent of Kenya's population within scarcely less than two-fifths of the total area of the country live in the Lake Victoria Basin. Within the regional setting Nyanza Province accounts for the majority of population, but Kakamega is by far the most populous district. Both Kakamega and Kisii districts exhibit alarming rates of population density. However, district densities mask locational density differentials which crudely depict man-land ratio: for the two districts the highest densities exist in Kisa (393), Nyang'ori (450), Tiriki (506), East Bunyore (530), West Bunyore (532), South Maragoli (542), and North Maragoli (614) locations in Kakamega district; and also Majoge Chache (303), Majoge Borabu (320), Nyaribari Chache (331), Kitutu West (342), West Mugirango (367), Kitutu West (415) and Kitutu Central (472) locations in Kisii district. Lower densities, but generally above 100 per sq. km., are recorded in the rest of the districts.[7] Rainfall distribution has a telling effect on the pattern of population distribution and densities, and the higher the rainfall the better is its reliability hence enhancing food production for sustenance of the population. These densities suggest that a few pockets of population pressure exist in the region while rigours of climate resulting in drought, famine or floods regulate population re-distribution, thereby intesifying out-migration. Some parts of the lake shores which were colonised by tse-tse fly many years back have remained virtually uninhabitable, a menace that has partly contributed to population nucleation around certain habitable areas. Persistent flooding along river banks in the flood plains, the result of irregular climatic drama, has drastically affected population distribution, and aroused much debate pertaining to rational management of water resources. As argued later in the paper the Kano Plains and Bunyala

7. United Nations Economic Commission for Africa, Application for Demographic Data and Analysis to Development Planning, African Population Studies Series, No. 1, 1973.

Table 1. Distribution of population, area an density in the Lake Victoria Basin Districts, 1969 - 1989.

District	Area in sq. km.	Population ('000)				Population density per sq. km.		
		1969[a]	1979[b]	1989[b]	Sex Ratio (M/F)100	1969	1979	1989
NYANZA PROVINCE	12,525	2,122	3076	4,437	97.4	169	246	354
Kisii	2,196	675	962	1,388	100.9	307	438	632
Kisumu	2,031	401	598	863	103.6	193	294	425
Siaya	2,534	383	533	768	84.3	151	210	303
South Nyanza	5,714	663	983	1,418	98.2	116	172	248
WESTERN PROVINCE	8,233	1,323	1947	2,893	93.8	162	237	352
Bungoma	3,074	345	538	799	97.1	112	175	260
Busia	1,629	200	268	398	90.3	123	165	244
Kakamega	3,520	783	1141	1,696	92.6	232	324	482
R. VALLEY PROVINCE	7,635	688	1042	1,434	106.4	87	136	189
Kericho	4,890	479	753	1,036	106.7	98	154	212
Nandi	2,745	209	289	398	104.5	76	105	145
LAKE BASIN	28,333	4,133	6065	8,764	97.6	155	214	309

*Rift Valley Province here refers to Kericho and Nandi districts only. Figures for the province therefore relate to these two districts.

Source: [a]Republic of Kenya, 1969 Population Census, Vol. IV: Analytical Report. Central Bureau of Statistics, Ministry of Finance and Planning, Nairobi.

[b]Population profiles for the districts of Kenya, Population Studies and Research Institute, University of Nairobi, 1979. These are based on low projection whereby fertility is regarded as constant.

Table 2. Distribution of urban population and sex ratio in Lake Victoria Basin, 1969

Urban Centre	Total Population	Percent of Lake Basin Urban Population	Percent of National Urban Population	Sex ratio (M/F) 100
Kisumu	32,431	44.7	3.0	126.3
Kericho	10,144	14.0	0.9	140.8
Kakamega	6,244	8.6	0.6	129.9
Kisii	6,080	8.4	0.6	150.6
Bungoma	4,401	6.1	0.4	127.8
Homa Bay	3,252	4.5	0.3	133.8
Londiani	2,994	4.1	0.3	103.5
Kipkelion (Lumbwa)	2,577	3.6	0.2	116.7
Kapsabet	2,298	3.2	0.2	121.2
Migori	2,066	2.8	0.2	141.4
LAKE BASIN	72,487	100.0	6.7	

The pattern of population distribution and density has important implications for development planning in the Lake Victoria Basin. Among other things, it stands to influence the distribution of water and other resources in quantities commensurate with population densities and distributional characteristics. Considered in the context of population - land use interrelationships, these two indices of spatial settlement are crucial in formulating development policy in accordance with demographic realities. The L.B.D.A. will also have to broaden the infrastructural base of the ten urban centres and other industrial modes in the sugar-belts including Webuye, in order to meet the challenges posed by expansion of agro-industrial activities in the region.

Aspects of Population Structure

Central to development planning are several demographic and socio-economic aspects of population structure. These include demographic traits, such as ethnic or tribal origin, age - sex structure and socio-economic characteristics, namely, marital pattern and status, educational attainment and economic participation rates which directly influence and are in turn influenced by trends in planning and development.

The Lake Victoria basin is a predominantly African reserve where the non-African population are found concentrated in urban centres as well as the former "Scheduled Areas" of commercial farming. Table 3 shows the ethnic structure of African population in the region. Although these figures relate to tribal groups enumerated throughout the country, they do not, in the final analysis, differ significantly from de jure population. This is attributed to the fact that despite their migratory behaviour, population originating from the lake region are known to regard it as their "usual place of residence" hence the need to plan the region with this trait in mind. The Luo and the Luhya are by far the majority and incidentally those who have the highest propensity to out-migrate, ultimately returning to settle in their rural homes. Other tribal groups are relatively sedentary but have recently shown a tendency to out-migrate; a notable case in point are the Kisii whose area of settlement has begun to experience population pressure. Both the Luo and Luhya groups occupy areas most susceptible to adverse effects of drainage system along the lake shores, and have consequently to adjust readily to several environmental problems. These and other area and ethnic discrepancies have much bearing on regional planning in the lake basin. Recent influx of other tribal groups as well as non-African population in the region has augmented population size, now above 8 million.

Age-structure has far-reaching implications for planning because it has to cater for various "phases of life" and "tastes of the population" at different phases. The three important age-brackets consist of children (0-14 years), working-age population or the labour force (15-59) and old-age population (60 or more years). However, Table 4 gives age-bracket categories that almost reflect consumptive cum productive capacities of population. These age-brackets are thus formulated to relate them to the current emphasis on education designed to produce highly skilled manpower who would be competent for designing, implementing and appraising development programmes in the light of demographic as well as socio-economic realities in the region, and within the wider perspective of national and international development. Since 50.0 percent of the population are children of primary school (17.6) and secondary school up to university education (a total of about 68.0 percent) ages, they do not participate in the development of the Lake Basin economy; they are consumers who depend heavily on a much smaller proportion of economically active population, aged 25-29 years (22.5) percent). Those aged above 50 years are mostly population in the

Table 3. Ethnic structure, and change and growth of African population in Lake Victoria Basin, 1962 - 1969.

Tribal Group	1962		1969		Percent
	Population	Percent	Population	Percent	Change
Luo	1,148,335	33.5	1,521,595	33.1	32.5
Luhya	1,086,409	31.7	1,453,302	31.6	33.8
Kisii	538,343	15.7	701,679	15.3	30.3
Kipsigis	341,771	10.0	471,459	10.2	37.9
Nandi	170,085	5.0	261,969	5.7	54.0
Teso	72,357	2.1	85,800	1.9	18.6
Kuria	41,885	1.2	59,875	1.3	43.0
Sabaot	28,012	0.8	42,468	0.9	51.6
TOTAL	3,427,197	100.0	4,598,147	100.0	

Source: 1969 Population Census, Vol. IV: Analytical Report, p. 22.

process of retirement and therefore pre-occupied with matters associated with old-aged security as well as that of children on whom they have spent their life-long savings and investments. Dependency ratio has telling implications for development of the region. Four districts experience dependency ratios below and five others have ratios above the average for the Lake Basin. In general, there is heavy dependency ratio which underlines the momentum of the population problem, engendered among other things by the burden of consumers shouldered by a thin base of labour force, a sizeable proportion of whom have no formal employment either. Over the last decade since 1969 census the rate of population growth has accelerated thus increasing the proportion of children and augmenting the burden on the labour force most of whom have no dependable employment.

High educational attainment characteristic of the Lake Victoria Basin districts has generally had adverse effects on its development. Moreover, it seems to be an "inertia" of many decades past since contemporary trends show the region as lagging behind the more privileged areas such as Central Province, at least over the last fifteen years. Added to this,

Table 4. Functional aged-bracket categories and dependency ratio of population in Lake Victoria Basin.

	Aged-bracket category (in years)				
	0-14	15-24	25-49	50 and over	Dependency Ratio (Pop. 0-14-60) Pop. 15-59
NYANZA PROVINCE	49.9	18.0	22.8	9.3	120.4
Kisii	55.4	18.2	19.7	6.7	143.8
Kisumu	45.3	19.5	25.6	9.6	99.1
Siaya	47.5	15.8	23.4	13.3	119.7
South Nyanza	48.4	18.2	24.0	9.4	113.8
WESTERN PROVINCE	52.3	17.4	20.4	9.9	136.5
Bungoma	52.8	18.6	20.4	8.2	134.1
Busia	49.8	15.7	23.6	10.9	125.1
Kakamega	52.7	16.0	19.6	10.4	140.66
RIFT VALLEY PROVINCE	47.7	18.5	24.6	9.2	
Kericho	51.1	19.2	21.8	7.9	124.8
Nandi	46.8	17.3	24.2	11.6	115.8
LAKE BASIN*	50.0	17.6	22.5	9.8	124.1

Note: * Average of the nine districts.

the majority of educated people are often enumerated outside their usual residence, i.e. in their places of work or in-migration. Table 5 reveals educational attainment of the de facto population as reported in the last census. Considered against the national picture, regional levels of educational attainment in the table tend to be higher than the national average. The dichotomy between Nyanza, Western Provinces and Rift Valley Provinces is evident especially at the lowest levels and in "none/not stated" categories. Preponderance of the last category is a menace to development

planning because the majority of population will have to be made functional literates if they have to keep abreast of and adjust readily to development programme envisaged in the region. Besides, the tendency for highly educated population to migrate outside the lake basin demonstrates that investment in education and subsequently manpower is wasted because that manpower benefits other regions of the country. A policy will have to be devised for making this massive human resource benefit the region that has nurtured, nourished and enhanced its skills; and one wonders whether a complex development programme of the calibre of the L.B.D.A. would not deploy its local natural and human resources for development challenges that it has to face up to.

Table 5. Educational attainment by specified levels of population in Lake Victoria Basin, 1969.

District	Educational level reached (percent)				
	None or not stated	Primary Stds. 1-4	Stds. 5-8	Secondary Forms 1-1V	Forms V+
NYANZA PROVINCE	75.1	12.5	10.5	1.8	0.2
Kisii	74.9	13.1	10.2	1.7	0.2
Kisumu	71.7	13.0	12.3	2.7	0.3
Siaya	77.2	12.3	9.1	1.3	0.1
South Nyanza	76.1	11.6	10.5	1.7	0.1
WESTERN PROVINCE	68.9	16.6	12.3	2.1	0.2
Bungoma	64.7	17.4	15.1	[illegible]	0.2
Busia	76.0	12.8	10.1	1.6	0.2
Kakamega	69.0	17.2	11.7	1.9	0.2
RIFT VALLEY PROVINCE	78.6	10.8	8.8	1.6	0.2
Kericho	75.2	12.3	10.7	1.6	0.2
Nandi	78.5	12.0	8.5	0.9	0.1

Population Growth and Re-distribution

Kenya's rate of population growth has become the centre of interest and the focus of attention of a broad spectrum of people and institutions involved in the demographic dimension of development planning. Since World

War II it has been galloping consistently from just about 3.0 percent in the 1940's and 1950's to 3.3 percent in the intercensal period 1962-1969 and since 1975 to 3.5 percent and more. This increasing trend may be attributed to availability and improvements in analysis of demographic data. But it must also be seen in the context of an amalgam of factors that influence demographic trends: scientific and technological advances which have improved individual as well as public health and environmental sanitation, the ever widening gap between fertility and mortality, especially during Kenya's stage of demographic transition, which increases growth rates; consistently increasing life expectancy, now nearing 50 years for males and over 50 years for females. Above all, it must be seen in the context of the demographic profile it has created at present,not least the future profile that will be influenced by current attempts to regulate the demographic upsurge. Meaningful demographic accounting in Kenya has been formalised only in the post-war period. Except for Siaya and Busia all districts in the Lake Basin record growth rates generally above the national average. (Table 6). Yet this is a densely populated region whose boundaries are conscripted by certain physical barriers as well as human activity which tend to intensify population-resource imbalance. Imagine the stagnating lake region economy whose development has yet to "take off", "mature" while sustaining the rapidly increasing population. In specific terms, imagine a situation in which 8.8 million (low projection) or 9.2 million (high projection) people live before most developments within the framework of the L.B.D.A. are articulated during the next decade or so. Increase of population is due to the three dynamics of population change, namely, fertility mortality and migration. In a region such as the Lake Basin where out-migration is the rule rather than the exception of population change, the effect of migration in fact reduces the rate of population growth which would otherwise be higher. Crude measures of fertility and mortality (birth rates and death rates) give the whole region a nature increase of 3.2 percent per annum. There are expected to be substantial increases in population of the region since the last census and during the next decade. But the widening gap between fertility and mortality suggests that the rate of population growth will not be regulated markedly until perhaps the middle of the next century. Table 7 summarises total fertility in the region. Both Kakamega and Kisii districts emerge as areas of high total fertility. As has been seen in an earlier section of the paper the two most densely populated parts of the Lake Basin have the best prospects for increased growth rates thereby aggravating the problem of population pressure which has started to show its ugly faces. On the whole, the Lake Basin is a region of rapid population growth, albeit the much out-migration it experiences.

Table 6. Population growth and projections for Lake Victoria Basin Districts 1962-1989.

District	Population ('000)				Population growth %		
	1962[a]	1969[a]	1979[b]	1989[b]	Rate of increase (%) 1962-1969[c]	Percentage 1969-79	Change 1979-89
Kisii	526	675	962	1,388	4.8	70	69
Kisumu	302	401	598	863	4.0	67	69
Siaya	326	383	533	768	2.4	72	69
South Nyanza	482	663	983	1,418	4.6	67	67
Bungoma	242	345	538	799	6.4	64	67
Busia	172	200	268	398	2.4	75	67
Kakamega	600	783	1,141	1,696	3.8	69	67
Kericho	391	479	753	1,036	3.2	64	73
Nandi	119	209	289	398	5.6*	72	73
LAKE BASIN		4,133	6,065	8,764		68	69

Note: *This figure is inflated partly by confusion in identifying different Kalenjin-speaking peoples and partly by boundary changes.

Source: [a]Census tables for 1962 and 1969 censuses.

[b]Population profiles of the districts of Kenya. Population Studies and Research Institute, University of Nairobi.

[c]Republic of Kenya. Nyanza, Western and Rift Valley Provinces Regional Physical Development Plans (Town and Country Planning, Ministry of Lands and Settlements, Nairobi, 1970).

Table 7. Total fertility in Lake Victoria Basin, 1969.

District	Total Fertility (sum of A.S.F. Rates) x 5	Deviation from Lake Victoria average	from National average
Kisii	7.27	+0.63	+0.67
Kisumu	5.61	-1.03	-0.99
Siaya	5.98	-0.66	-0.62
South Nyanza	5.75	-0.89	-0.85
Bungoma	8.18	+1.54	+1.58
Busia	6.53	-0.11	+0.07
Kakamega	8.12	+1.48	+1.23
Kericho	6.00	-0.64	-0.64
Nandi	6.34	-0.30	-0.26
LAKE BASIN	6.64		

Note: National average = 6.60

Large-scale migration has re-distributed the lake basin population in different regions of the country. Cross-tabulation of "birthplace" and "usual-residence" underlines this re-distributive characteristic. Take Nyanza and Western Provinces which are net out-migration areas. Of population reporting their birthplace in Nyanza, by 1969 14.0 percent were resident in Nairobi, 4.7 percent in Central Province, 11.6 percent in Coast Province, 5.8 percent in Eastern Province, 2.3 in North Eastern Province, 18.5 percent in Rift Valley Province and 15.5 percent in Western Province. The Corresponding proportions for population born in Western Province were: Nairobi (14.2), Central (3.5), Coast (6.2), Eastern (4.3), North Eastern (2.1), Nyanza (13.2) and Rift Valley (2.1). In planning-resource terms, the lake basin is a "downward transitional" region losing population to the "upward transitional" and 'core' regions in rural economic islands and urban centres respectively.[9]

9. Ominde, S.H. and Ondingo, R.S. Demographic Aspects of Regional Inequalities in Kenya. Paper for Commission on Regional Aspects of Economic Development, Brazil, 1971.

Migration of population is therefore seen as a blessing in disquise; it alleviates the burden that would be experienced if population were sedentary. Available data on migration are imperative for planners who will be involved in the region's transformation; they rationalise needs and areas of emphasis in the planning process.[10] Table 8 shows intra-regional migration in the Lake Basin.

The demographic protrait of the lake basin just given may appear irrelevant for purposes of the Lake Basin Development Authority. But without it we may make irrational appraisal of the demographic dimension of regional development. In the rest of the paper, attention is focussed on relating the demographic background to the design, strategies, programme implementation as well as evaluation of the L.B.D.A. Success of the project will have to depend not only on perceptions of expert planners, policy and decision makers; it will also depend on perceptions of the planned at the individual and community levels and in totality of the whole region's development requirements.

As shown in Table 9 there is considerable exchange of population between all districts in the Lake Basin. Notable exceptions are, no population transfers between Kisii and Busia perhaps due to the distance factor; between South Nyanza and Busia also attributable to the same factor; and between Nandi and Busia. It is apparent that Busia seems to lie outside the long established migration streams often terminating eastwards, i.e. at the commercial farming areas and the major urban centres. This information reveals the net migration patterns which could influence subsequent diversification of migration streams towards anticipated development nodes in the Lake Basin.

FOCUSING DEMOGRAPHIC ISSUES ON THE L.B.D.A.

It must be emphasized at the outset that the L.B.D.A. has to be autonomous to mount a workable machinery for planning development of the region. This autonomy presupposes harnessing diverisified expertise on aspects of development that are envisaged to constitute a broadly based, self-servicing and consultancy oriented Authority. Thus the working documents for the L.B.D.A. should be ambivalent, giving background information against which development of the basin will evolve and using that information as basis for mapping out a pragmatic approach to the development process.

---

10. One of the most useful studies has been made by Henry Rempel on inter-district transfers of population. See Rempel, H. An Analysis of the Information on Inter-District Migration Brovided in the 1969 Kenya Census. Discussion Paper No. 244, Institute for Development Studies, University of Nairobi, January, 1977.

Table 8. Percentage distribution of the sources of migration within Lake Victoria Basin districts.

Birth place		Sex M or F	Destination A	1	2	3	4	B	5	6	7	C	8	9
A: NYANZA PROV.		M	23.7	6.7	39.9	28.4	27.0	13.9	4.0	13.6	26.6	16.9	56.9	26.6
		F	31.5	5.6	47.0	36.7	40.8	15.8	1.8	18.5	27.7	12.5	51.5	21.0
J	Kisii	M	3.6		10.4	1.2	3.1	1.0	0.5		2.3	4.9	18.2	9.5
		F	2.5		7.3	0.3	2.7	0.5	0.1		1.2	3.7	19.8	7.6
2	Kisumu	M	8.7	1.4		20.2	17.9	4.5	1.8	2.7	9.2	6.2	19.8	12.3
		F	16.3	1.7		30.6	30.9	8.5	0.6	14.0	12.7	4.7	16.6	9.4
3	Siaya	M	6.5	0.7	19.1		5.4	7.1	1.3	11.0	11.9	2.3	2.6	1.3
		F	7.4	0.6	23.9		6.7	8.5	0.6	14.0	12.7	1.6	2.6	1.6
4	South Nyanza	M	4.2	4.0	9.4	6.5		1.2	0.5		2.8	2.8	15.1	3.5
		F	4.6	2.9	15.0	4.8		1.6	0.2		4.0	1.8	11.8	2.3
B: WESTERN PROV.		M	10.4	4.0	24.2	23.5	2.4	18.4	11.5	25.2	22.5	17.8	15.4	41.2
		F	11.4	5.9	19.2	31.5	2.3	23.8	12.9	26.4	32.6	16.0	11.1	41.2
5	Bungoma	M	0.7	0.3	2.2	0.6	0.1	3.4		8.9	4.0	3.4	0.4	1.8
		F	0.6	0.4	0.9	1.6	0.2	3.8		7.3	5.1	4.0	0.6	1.6
6	Busia	M	2.6	0.3	3.4	15.0		6.2	3.4		13.9	0.7	0.3	0.5
		F	2.7	0.2	2.5	13.4	0.1	11.3	3.8		25.5	0.6	0.4	0.5
7	Kakamega	M	6.8	3.2	18.4	7.8	1.9	7.0	7.7	16.1		13.6	14.6	39.0
		F	7.8	4.9	15.6	16.4	1.7	7.8	8.9	18.9		11.6	10.0	39.0
R.VALLEY PROV.		M	4.9	3.8	4.9	11.6	3.7	13.2	13.5	3.2	19.5	28.2	9.9	13.0
		F	3.8	3.2	4.0	8.3	2.2	11.0	11.1	2.0	16.5	30.7	13.8	16.5
8	Kericho	M	2.2	2.6	1.4	2.0	2.4	0.8	0.5		1.6	4.3		4.5
		F	1.4	2.2	0.9	1.0	1.3	0.7	0.2	0.1	1.6	3.8		6.5
9	Nandi	M	0.3		0.9	0.1	0.1	1.1	0.1		3.2	5.3	2.4	
		F	0.2	0.1	0.8	0.3		0.8	0.1		2.0	7.0	3.5	

Source: Rempel, H. An Analysis of the Information on Inter-District Migration provided in the 1969 Kenya Census. Discussion Paper No. 244, Institute for Development Studies, University of Nairobi, January 1977, Appendix C.

Experience in many countries has shown that there are certain demographic traits that feature prominently in development planning. A study of 70 national development plans covering the five-year period 1965-1972 has revealed that only 27 of them recognised population problems as distributed in Table 9.[11]

It is not the frequency distribution of the co-variates as seen by the researcher that is important; but perhaps their ranking as perceived by population who have to benefit from what is planned. The menu could be longer, but even as it is, it places the demographic factor in the proper perspective of development planning; its structure is most instructive for the L.B.D.A. within whose framework we now wish to consider it.

Table 9. Population problems recognised in Development Plans, 1965-1972.

Type of population problem	Total number of countries (N = 70)
Economic growth reduced by population growth	19
High rate of population growth (in and of itself)	18
Unemployment	18
Increasing school-age population	16
High dependency ratio	16
Population pressure on health services	15
Population pressure on social services	12
Population pressure on housing	12
Population pressure on agricultural system	5
Decrease in individual standard of living	4
Population density	3

Source: Maxwell Stamper, "Population policy in development planning" Reports on Population/Family Planning, No. 13 (May 1973), p. 5.

---

11. Quoted in W.C. Robinson Population and development planning (ed.) (New York: The Population Council, 1975), p. 3.

A Demographic Unit of the L.V.B.D.A.

Usually, planners have recognised the fact that planning is for and of population. But it is the central thesis of this paper that planning is basically with the population who must be and themselves feel to be involved in all the stages. A planning institution must of necessity develop a workable structure that would facilitate mutual exchange of ideas as well as of articulating needs between the planner and the planned. One would therefore like to see the L.V.B.D.A. as an autonomous umbrella organisation consisting of diversified but well co-ordinated units each dealing specifically with different issues: demographic surveys, land and resource utilisation, medical and public health obligations, economic and commercial interests, agro-industrial activity, socio-cultural norms and values, legal and fiscal matters, to identify a few areas of concern.

The demographic unit would be the chief source of collecting, analysing, publishing, disseminating and evaluating demographic data. Structurally, it would consist of a director and his assistants manning specialised sub-units and themselves specialised in different fields of demography; and a team of field assistants whose main task would be to collect primary data regularly or as and when directed by the unit. The director would be advised by an advisory council answerable to the chief executive of the L.B.D.A. through the director of the unit. In order to function efficiently the unit may have to depend heavily on the Population Studies and Research Institute at the University of Nairobi whose training programmes could intimately serve the interest of the L.B.D.A. and whose staff may carry out independent studies to inject external evaluation into the demographic unit. Within its short existence the Institute has demonstrated its scope for such an exercise.[12] Thus the autonomous stance of the L.B.D.A. would be reflected on such regional needs as expressed by the population and/or as discovered by all component units in their researches. In development planning it may not be true that "we are attempting to satisfy

---

12. The Population Studies and Research Institute has been organising regional seminars on the population data needs for planning, starting with Nyanza/Western to Central/Eastern and later other areas where provincial and district officers discuss a wide range of issues raised in publications prepared by the Institute itself. Publications so far cover provincial population data, their uses and abuses. Population projections for provinces, districts, urban centres on alternative fertility paths, etc., have also been published.

the needs of people by the services and efforts of other people".[13] As has been mentioned above, the people's own involvement in planning has much to commend it, especially in regional planning where individual, community and regional means of re-distributing development and correcting intra-regional inequalities would be to use the pattern of population distribution and density as an index of the whole exercise.

Demographic Accounting in the Lake Basin.

The most fundamental requirement for demographically oriented planning is the demographic profile as explained in the first part of this paper. This calls for a viable data storage, usually through censuses, sample surveys and vital registration which yield data on a wide range of demographic phenomena. The demographic unit of the L.B.D.A. would be well placed to mount periodic canvassing of the total population or conducting surveys on its particular characteristics as demanded by planning needs. Chances are regionally based demographic accounting is likely to be more successful and therefore to yield better data than nationally spread exercises which conceal significant regional disparities and hardly unveil peculiarities. Adequate investigation would have to be made on attitudes of the population to the processes of collection in order to discover inherent problems besides impressing upon them to appreciate its very purpose in the context of development.

Secondary sources of data would also have to be encouraged from administrative records which have remained routine reports hitherto. Administrators themselves, in the Lake Basin administrative units, will also have to be exposed to the importance of demographic data. Only this way can their support be ensured in a programme where their involvement is most crucial.

Re-organisation of Settlement Pattern in the Lake Basin.

Micro-ecological regions in the Lake Basin and their inherent features as well as problems will necessarily require re-organising the settlement pattern of the population. In the drier lowlands along the lakeshores low and erratic rainfall has created the problem of lack of clean water for domestic as well as livestock uses. Attempts to reticulate pipe

---

13. Brass, W. Population Data Needs for Development Planning, is S.H. Ominde and C.N. Ejiogu (eds.) Population growth and economic development in Africa (London: Heinemann, 1972), p. 343.

water in Uyoma Peninsula in Siaya District, Nyakach area in Kisumu district and Karachuonyo in South Nyanza district within the immediate lacustrine niche has led to serious abuses like irregular supply of water due to un-repaired machinery as well as pipes or illegal sale of diesel for machines to owners of out-board motor canoes in the lake; reticulated water supply which is inconsistent with the pattern of settlement in the area; and a host of other problems.

Moreover, domestic use of water is by far less important than that intended to effect change in the rural landscape, whether in modernising agriculture or industry. A major programme to this end would have to involve irrigation or relevant dry farming methods. This would regularise subsistence farming; besides, it would encourage cash crop production in perishable and annual crops, notably horticultural crops, rice and cotton. Such innovations have the capacity to raise standards of living of the population, not least foster agricultural development, an integral aspect of the L.B.D.A., in the region.

In flood-plains of the notorious Nyando (Kano Plains) and Nzoia (Bunyala lowlands) rivers the construction of levees to avoid flooding, a popular slogan in various circles, does not seem to be the best of solutions. Persistent flooding has affected agricultural activity adversely, and engendered large-scale out-migration as a tentative alternative to remaining put in the area and facing the effects of flooding, such as famine, lack of shelter and erratic life in general.[14] Within this ecological niche there will be need for the L.B.D.A. to conduct multi-purpose surveys that would gauge opinions of the population on what they would like included or deleted in changing the face of the floodplain and rendering it permanently habitable. Now is the time for implementing lessons learned over the past decade or so on pilot irrigation schemes vis-avis subsistence economy in the area while making them retain their land rights or receiving compensation in the process of developing agro-industrial transformation of their region. The legal and socio-cultural implications of this need careful consideration. This re-settlement programme should be effected against the background that further expansion of settlement in the two flood-prone areas is conscripted by the encroaching sugar-belts, now given greater emphasis than ever before in the regional economy.

---

14. Insight into the determinants of out-migration has revealed that flooding, which ranks highest, is a menance of development efforts in the area. See Ayiemba, E.H.O. Inter-censal Population Change: A Comparative Study of Kano Plains and the Sugar-belt. (Unpublished M.A. Thesis, University of Nairobi, 1974).

Which leads us to consider the current over-emphasis on sugar growing in the area at the expense of other cash crops and food production. A major question is whether the sugar industry takes into account interrelated problems: land tenure and use, for instance, the diminishing and fragmented land acreages per household which are grossly uneconomic but most of which have been mortgaged as land title-deeds for agricultural and other loans, thereby intensifying land use - human settlement competition. Indiscriminate expansion of the sugar industry has far-reaching agro-industrial, political, economic and social repercussions, particularly with regard to increasing population densities and handicapping other development efforts. Unless some system of "vigilisation" is adopted to re-distribute population in accordance with the development programme, the haphazard distribution of population, land uses and other activities stands to disrupt regional planning priorities.

In the Lake Region savannahs a cloud of fear still hangs over the formerly tsetse fly- infested areas. These include the Lambwe Valley, accordingly turned into a wildlife reserve but in parts used as farmland and the low-lying parts of Siaya and Busia districts. It will be imerative for the L.B.D.A., in conjunction with the International Centre for Insect Physiology and Ecology (I.C.I.P.E.) operating from its base at Mbita Point in South Nyanza (a former tsetse fly "colony"), to wipe out this menance, dispel the myth of its existence and convince the population as to the suitability of the whole region for settlement. Population moved from the foodplains or densely populated parts could be re-settled in these areas. Alternatively, those areas could be turned into agricultural land as determined by ecological conditions and developed by appropriate scientific and technological approaches.

The highest parts of the lake basin which now experience population pressure pose another development challenge within the L.B.D.A. Kisii and Kakamega districts have become classical examples through newspaper reports, scholarly researches, government reports and even in the perception of the local population. Sizeable chunks of land in these districts are also too rocky to be cultivable, albeit more productive than expansive farm units in the lower ground. Re-settlement is necessary in this area whose re-organisation into respective land uses as ecological conditions permit could be the source of nutritional resources for the whole lake basin. Part of the re-settlement stream could be directed to parts of the former "Scheduled Areas" where lower population densities are experienced, and where much of the land is not utilised effectively.

Table 10. Selected demographic, edaphic and agricultural indicators in Lake Victoria Basin districts.

District	Total Population 1969	Pop. density persons per sq. km.)	Hectares ('000)	Hectares per person	Area under cash crop as % of cultivated area	% of high-potential agricultural land
Kisii	675	304	220	0.3	31	100.0
Kisumu	401	192			21	93.7
Siaya	383	151	438	0.6	9	
S. Nyanza	663	114	567	0.9	20	99.1
Bungoma	345	113	253	0.7	13	82.1
Busia	200	119	163	0.8	20	100.0
Kakamega	783	220	325	0.4	13	92.3
Kericho	479	97	380	0.8	16	77.7
Nandi	209	75	234	1.1	8	

Source: Adapted from Tables 1 and 28 in ILO, Employment, income and equality: a strategy for increasing productive employment in Kenya (Geneva: ILO, 1972)

Table 10 shows that the most densely populated districts have the lowest hectares per person; Kisii and Kakamega exhibit these conditions. A further dimension of land hunger in these and other districts is inherent in the land tenure system which involves perpetual land fragmentation, thereby consistently reducing land sizes to uneconomic units. Cash cropping has great scope in all the Lake Basin district. Nearly half of the districts have more than one; fifth of their area under cash crops. This is attributable among other things to availability of high proportions of high-potential agricultural land.

Urban centres in the lake basin share one common problem, namely persistent water-shortage irrespective of location, size or infrastructural base. Apparently, all of them still depend upon water reservoirs constructed during the colonial period, when the colonial administration readily asserted that the African population were but temporary urban dwellers, returning to their rural homes as soon as their labour was no longer required. The colonial policy devised an appropriate policy to regulate rural-urban and the counter-migration streams. But since independence practically every urban

centre in the country has experienced an expanding influx of population, augmenting urban population more rapidly than anticipated before. Which urban centre in the lake basin has no water problem? Simply none. Water shortage in Kisumu has nearly crippled domestic consumption and industrial uses in a town where the famous Kisumu Cotton Mills (KICOMI) nearly closed down recently because of the problem and where the plants for Kenya Breweries as well as the Molasses industry now under construction will demand water twice the present domestic consumption. The Kibos stream near Kisumu is too small and has too fluctuating volume to be the source of water supply for the town. Kisii in the heart of heaviest rainfall in the area faces frequent water crisis; it is, indeed, one of the filthiest towns in the country, part of the story being the piling garbage of green produce from the immediate hinterland with no water to drain it away to the sewage terminal. This poses an environmental problem in an area where an epidemic of any disease would decimate a considerable proportion of the population. Kakamega town in another heavy rainfall area suffers from persistent water shortage. Smaller urban centres such as Bungoma, Homa Bay and Migori experience a most pathetic situation, despite their sprawl around their initial extent. Both Kapsabet and Kericho are much better than all the other urban centres thanks to less rapidly increasing volumes of migrants into them. This paper would like to argue that Lake Victoria should be the major source of gigantic water reservoirs which should be constructed to supply water to rural as well as urban areas in the basin. As the nodes of industrialisation, urban centres are soon going to exert a commanding demand for water which only the lake can be its most dependable source. Harnessing the lake water in such reservoirs would also facilitate irrigation and other uses in the riparian areas of the drainage system within the basin.

Population Policy for the Lake Basin Districts.

The basic connotation of population policy relates to regulating fertility as a means of reducing the rate of population growth thereby enhancing prospects for socio-economic advancement of population. But this seems a parochial and myopic concern, at least in the fact of demographic profile as well as trends in the lake basin districts. These are high fertility, densely populated and population problem districts where population policy ought to encompass dynamics of fertility-mortality interplay, population movements and development process in the urban hierarchy in the region.

That the natural increase of the lake basin population exceeds the national average suggests it is a pocket of population cum resource problem. Fertility regulation, popularly known in the country as family planning, is therefore inevitable in the area. However, it must incorporate both traditional and modern tendencies particularly in an area where the local ethnic groups are known for their strict adherence to spacing of births, the cardinal emphasis in the family planning programme. It is common knowledge, now even documented, that the Luo, the Luhya, the Kisii, the Kuria, the Teso and the Kalenjin are some of the few Kenyan peoples still cherishing traditional norms and values of fertility regulation: post-partum abstinence encouraged by polygamy, avoidance of coital relations of husbands and wives and governed by traditional rituals; coitus interruptus whenever deemed necessary; and other traditional techniques of family planning.[15] In the modern setting family planning has adopted modern techniques (the condom, the intra-uterine devices, pills, spermicidals, etc.) with no regard whatsoever to traditional techniques and, more important, without mounting before-hand KAP/fertility surveys on the basis of which viable family programmes could rationally be developed. Using the demographic and other appropriate units the L.B.D.A. could mount family planning within the framework of planning in totality, placing greatest emphasis on a "blended approach". Then alternative paths of fertility-mortality performance, with or without the effect of migration, could be graphed and population projections made against which the L.B.D.A. development would be considered.

Movements of population is another area which demands population policy. The laisse faire trend in the phenomenon has persisted, and several attempts to regulate migration have been unsuccessful; the Vagrancy Act is a telling case in point. The basic policy should be to encourage intra-regional migration and discourage out-migration. A strategy already being adopted is the "growth centre" approach which urban and regional development plans emphasise to create a coherent centre - periphery relationship. The present urban centres should now develop a broad infrastructure to service their peripheral regions, reduce intra-regional inequalities and maintain relationship with "lower order" centres within the urban-regional hierarchy. The L.B.D.A. could also design a dossier for every person in the region, a

---

15. In a survey of about thirty tribes in East African, Angela Molnos has examined the knowledge, attitudes and the practice (KAP) of family planning among different African population groups. See Molnos, Angela. Cultural Source Materials for Population Planning in East Africa, Vols I-IV (Nairobi: East African publishing House, 1972).

device that facilitates following migration histories of the population.[16] This idea has the advantage of giving a more accurate picture of population movements than net-migration estimates made from census or survey data.

Other Population Characteristics

It is not an easy exercise to identify all the characteristics of population that affect or are affected by regional development. Those given above are perhaps the most basic in any given situation. But other characteristics may arise depending on different items of planning and development in the Lake Basin. This is precisely collaboration with other components of the L.B.D.A. Yet a peculiar feature of the demographic unit is perhaps its capacity to give development programme the sketches of population characteristics which constitute an integral aspect of broadly designed planning and development.

CONCLUSION

The length of this paper may be justified by the last statement in the preceding section. Throughout the paper it has consistently been maintained that demographic information is crucial for development of the Lake Victoria Basin. It is therefore imperative that a demographic unit will have to be set up along other units in an autonomous, self-reliant but "open systemic" Lake Basin Development Authority. On the basis of demographic - resource considerations, planning and development in the L.B.D.A. may group the nine districts into four categories. First, there are the two "population problem" districts of Kakamega and Kisii where demographic trends pose significant challenges to development planning in the Lake Basin. These need to be examined more closely if a meaningful solution is to be found. Second, the generally low lying parts, basically Siaya and Busia districts as well as the immediate lacustrine South Nyanza and Kisumu districts, require more detailed study of demographic-ecological implications for the L.B.D.A. Third, Bungoma and much of South Nyanza district, large parts of which have promising prospects for development, fall in a category of their own. Their potentials put them in good stead

---

16. Sweden is one country which has successfully used dossiers and parish registers to study migration of population which is then easily related to the development programme.

for this regional development programme thanks to modest distribution and density of population. Finally, Nandi, Kericho and the sugar-belt in Kisumu district constitute an area of greatest economic potential and may well be the economic backbone of the L.B.D.A. Already, sugar-belts in the three are merging forming one of the most extensive commodity landscapes in a region. It is tempting to conclude that these micro-regions have great scope for the transformation of the entire lake basin and for ensuring the existence of a comprehensive regional planning cum development in the aegis of the Lake Victoria Basin Development Authority.

"EDUCATIONAL NEEDS AND SERVICES FOR THE LAKE VICTORIA DEVELOPMENT AUTHORITY"

By

Prof. S.H. Ominde
Director Population Studies and Research Centre
University of Nairobi

1. INTRODUCTION

Since the liquidation of political forms of colonial domination in the developing world, the development debate has been plagued by a plethora of development models and the issue is far from settled. The world is currently entering another phase of such confusion brought about by the pressures of the existing world economic order and particular life styles based on overdependence on the power supplies of fossil fuel. Kenyans are not immune from this global system.

The discussions of educational implications of the Lake Victoria Development Authority is therefore faced with serious contradictions not only in the current state of development debate in the world but also by immense problems which our educational planning continue to pose. One such paralysing contradiction is the persistent treatment of development of material and human resources as if they were unrelated entities. The other problem is the tendency to consider them outside the general framework of the nation as a whole.

In the larger context of development dialogue our discussions are taking place at a time of important but permanent shift from sectoral concern of development that had down played the human side of the development coin to development of the people, by the people and for the people. Discussions of the basic needs approach and the importance of a frontal attack on the poverty of the majority of our people are no longer frowned upon but are now respectable and vital areas of national concern. It is this important switch that distinguishes our fourth National Development Plan from the previous plans. It is this that characterises the commitment of our President and the Kenya Government in facing the challenges and uncertainties of the last quarter of the 20th Century Kenya.

The establishment of the Authority pattern of development model may not be new in the Kenyan situation. What is new is the integrated and

wider regional dimensions and the basic concern for the contribution of the Authority to the solution of the problem of poverty in its many dimensions.

The Authority areawise may account for not more than 1/10 of the total area of Kenya where about 6/10 of the land area is marginal and semi-arid. In terms of resources and inputs into the national development effort, the Authority will affect a vital portion of the most productive part of the Republic. In this paper, the Authority area is taken to include the two core provinces of Nyanza and Western and the catchment districts of Kericho Nandi, Trans-Nzoia, Uasin Gishu and West Pokot. This broader definition which goes beyond the provisions of the Bill is consistent with the wider international implications of the Authority functions. On the basis of Low and High projection, the area covered currently contains between 6.5 to million people. A more detailed breakdown of the population will follow.

In this paper, I propose to consider the human resource framework of the Development Area, the dimensions of the various functional age-groups over the plan period. Second, the paper focuses attention on the effect of overall national planning on the educational needs and services with special emphasis on the centre-periphery problem, the range of manpower available and the diversity of employment opportunities and infrastructural foundation for further development. Thirdly the paper will consider the basis of educational planning necessary for the effective contribution of the Authority. Fourthly, the paper concludes by underlining the urgency of laying down the institutional foundation for grass root attention to development problems of the area as part of the overall national development strategy.

11. HUMAN RESOURCE FRAMEWORK OF THE AUTHORITY'S AREA:

One of the basic constraint which has led to suspicion of the previous development plans is the extent to which they pay attention to demographic realities beyond the mere problem of the effect of rapid growth on development of scarce resources. Table (1) summarises the estimated and projected population of the Authority Area and neighbouring parts of the Rift Valley Province from 1969 to 1989.

It will be noted that in 1969, the Authority Area accounted for approximately 4.6 million people of which roughly 1/5 were in the peripheral parts of the Rift Valley Province and the remainder were in the Nyanza and Western Provinces. By 1979, forward projection of the total population shows that the Authority Area is expected to increase to 6.6 million. By

1989, the total population is expected to rise to 9.7 million on the basis of a low alternative rate of growth. Table 2 shows that in 1969 the population of the Authority Area accounted for 42.06 per cent of the total population of Kenya and that by 1979, the share is expected to account for 42.89 percent. These figures assume the present pattern of migration. A shift of emphasis in development west of the Rift is likely to increase this share further.

Table 1: Total population of the authority catchment districts 1969-1989

Year	Nyanza Province (sect 1 low)	Western Province	Rift Valley (part)	Total
1969	2,122,000	1,328,000	1,152,000	4,603,000
1979	2,958,000	1,947,000	1,713,000	6,618,000
1989	4,437,000	2,893,000	2,375,000	9,705,000

Source: R.A. Henin, Population Studies and Research Institute

Table 2: Authority area population as a percentage of total Kenya population 1969-1989

1969	10,943,000	4,603,000	42.06
1979	15,427,000	6,618,000	42.89
1989	21,887,000	9,705,000	44.34

Tables (3) and (4) shows the breakdown of total population for the two core provinces of Nyanza and Western by functional age groups. In quantitative terms, the population aged 0-4 in Nyanza is expected to increase from 590,000 in 1979 to about 852,000 in 1989 (Table 3). The Primary School-age population is expected to increase from 654,000 in 1979 to 943,000 in 1989. The Nyanza school age population expecting Secondary Education would rise from 311,000 in 1979 to 448,000 in 1989. The labour force population is expected to rise from 1,441,000 in 1979 to 2,079,000 in 1989 and the Adult population aged 60+ is expected to rise from 124,000 to 178,000 over the 10 year period.

Table 3 Population by age-groups in Nyanza Province

Nyanza Province

	1969	1979	1989
Total Population ('000)	2,122	2,958	4,437
Population aged 0-4 ('000)	407	590	852
School age population 6-12 ('000)	451	654	943
School age population 13-16 ('000)	241	311	448
Labour Force 15-59 ('000)	994	1,441	2,079
Adult population 60+ ('000)	85	124	178

Source: R.A. Henin, Population studies and Research Institute

In the Western Province (Table 4), the population aged 0-4 years will increase from 409,000 to 608,000 over the 10 year period from 1979. Demand for Primary School Enrolment will be intensified by an increase in the number of children aged 6-12 from 408,000 in 1979 to 606,000 in 1989. A similar pressure is expected in the Secondary School facilities by a rise in potential Secondary School population from 186,000 in 1979 to 276,000 in 1989. Pressure on job opportunities will be intensified by an increase in the labour force from 900,000 in 1979 to 1,338,000 in 1989. Persons aged 60+ will increase from about 63,000 to 94,000 between 1979 and 1989.

These figures underline the need to bear in mind the fact that the existing resources developed or undeveloped will have to cater for far larger numbers assuming the present trends in population growth. The overall aim of meeting the target of the Fourth Development Plan will be increasingly harder to achieve without a major attack on the whole problem of develoment of the human and material resources.

Table 4: Population by age groups in Western Province

Western Province

	1969	1979	1989
Total population ('000)	1,328	1,947	2,893
Population aged 0-4 ('000)	279	409	608
School age population 6-12 ('000)	289	408	606
School age population 13-16 ('000)	138	186	276
Labour force 15-59 ('000)	581	900	1,338
Adult population 60+ ('000)	61	63	94

Source: R.A. Henin, Population Studies and Research Institute

The problem of meeting the target of the Plan may be intensified because the demographic characteristics of a society are an important element in the determination of poverty in its complex inter-relations. Further, the demographic trends closely affect the access to and availability of resources needed for the elleviation of poverty and capacity of the society as a whole to generate additional requirements for the support of new members of that society.

It should be noted that the dependency burden measured by the number of people aged less than 15 years and over 60 years as a percentage of the population aged 15-59 is rather high in the Nyanza and Western provinces. In Nyanza it will remain at above 113 to the end of the plan period whereas in the Western Province, it is expected to be around 135 until about 1984 when it will slightly fall.

111. PLANNING EDUCATIONAL SERVICES IN THE AUTHORITY AREA

It reviewing the implications of the new shift in development planning it is pertinent to raise some of the historical constraints in educational planning. Over the last 15 years or so important advances have been made in quantitative increase in educational opportunities at the national level. However, in a very real sense, educational planning has continued to suffer from the centre periphery relationship inherited from the colonial era. Data which could be of use in studying the spatial trends in provision and quality of educational services are virtually unavailable. However, it is possible to see the relative standing of the Authority Area from the scanty information available (Tables 5 and 6). Using the crude index of opportunity or access to Form 1 places, the tables give the position of the Nyanza and Western Provinces and the neighbouring Rift Valley Province (Table 5)

Table 5: Admission to form 1 places as a percentage of Estimated population aged 13 by province - 1974-1975

Province	1974-75 Index (%)
Central	12.0
Coast	9.0
Eastern	8.5
Nairobi	22.5
North Eastern	3.0
Nyanza	6.5
Rift Valley	6.0
Western	9.0
National	8.5

Source: NCEOP. Task Force (3) Discussion Paper No. 3
Table 9 (b) p. 12

The index is far from satisfactory. However, it is possible to see the 'Centre-Periphery' relations here (Table 5). The capital City of Nairobi has a far higher index of opportunity of more than double that of the Nyanza and Western Provinces. Taking the admissions to Form 1 as a percentage of those aged 13 in the province, Nyanza had 6.5 per cent as against 9.0 per cent for the Western Province. It should be repeated here that this is not a fair measure because the percentage of intake into Form 1 is also based on the percentage of the Primary School going population. Provinces with low enrolment in Primary Schools will naturally appear to have low indices. But low enrolment could also be argued as a manifestation of poverty. Table 6 takes into account the Aided and Un-Aided School intake. Here again the Nyanza and Western Provinces are well below the national average.

Table 6: Provincial indices of opportunity (aided and Unaided schools (form 1 places as percentages of CPE candidates).

Province	Index (%)
Central	36.0
Coast	45.0
Eastern	26.0
Nairobi	97.0
North Eastern	47.0
Nyanza	22.0
Rift Valley	30.0
Western	28.0
National	32.0

Source: NCEOP. op.cit. Table 10 p. 13

Using a ranking method based on educational attainment of the total population aged 25 years and over in 1969, the proportion of school age children in school and the ratio of girls to boys in Primary Schools, (Kinyanjui[1] 1975) concluded that only Gusii, Bungoma, Kakamega, Laikipia and Uasin Gishu ranked as educationally advanced. Kisumu, Siaya, South Nyanza, Busia, Kericho, Trans-Nzoia and Nandi were educationally less advanced areas. West Pokot on the edge of the Authority Area was in fact ranked as educationally backward. These two exercises in evaluating the spatial

---

1. Kabiru Kinyanjui. Education and Formal Employment Opportunities for women in Kenya. Some Preliminary Data. Kenya Education Review Vol. 2 No. 2 December, 1975 p. 6-25.

aspects of educational services are cited to underline the fact that improvement in educational opportunities is an important aspect of the total development strategy. In another sense it is an indication that in the last 15 years, it has created problems which will introduce further constraints in the achievement of the overall objective of the Authority.

But a more significant aspect of educational services has been its contribution to the imbalance in the manpower situation. The area has suffered from a vicious circle of under-development which leads to the majority of the product of the system spending their most productive years outside in other parts of the country. The 'Centre-Periphery' relationship which has created most development opportunities has schemed off most of the products of Secondary and the vast majority of products of tertiary education. It is this that the implementation of development programme of Higher Education in the last 10 years has confirmed. Regions condemned to such a relationship cannot participate meaningfully in the new development strategy.

In this context, the shift to integrated regional development as envisaged in the Authority bill must also involve a carefully planned shift of High Level and Middle-Level Manpower development through institutional, industrial and resource development strategies. It requires a fresh look at educational planning as a framework for the achievement of the Authorities larger purpose.

IV. CONCEPTUAL, FRAMEWORK OF AUTHORITY'S TASK

The basic framework of the authority's challenge is its role in integrated rural/urban development of the area. Because of the differential impact of the development process and in particular the effect of the 'Centre-Periphery' pattern of development in the past, the high income products of the educational services in the Area are outside, leaving a vast reservoir of poverty only occasionally amelionated by rural/urban exodus to the national centres of economic growth.

The Authority as conceived underlines the great need for a much expanded research programme more specifically focussed on selected priorities of the area. Such research institutions as have been provided suffer from the sectoral and export oriented consumer market which they serve. In many respects, the existing research services are insufficient in supporting manpower and research resources. It is therefore essential to review the overall programmes of educational institutions especially tertiary educational institutions.

Another conceptual dimension is the need for grassroot involvement with research problems in the totality of their complexity. The kind of research I have in mind here is not the research whose findings are merely exported. There is the important task of ploughing back the findings of research in the solution of development problems in the region through increasing popular participation. Stated in another sense, the conceptual challenge is for an integrated human resource development. The Authority functioning could only change the situation for the better by exposing the serious gaps in manpower that act as constraints to development push required to improve the condition of the entire population and the country as a whole.

V. THE AUTHORITY TASK AND A COMPREHENSIVE PLAN OF EDUCATIONAL SUPPORT SERVICES

First, we need to remind ourselves that Kenya's Fourth Development Plan, the aims of which the Authority is intended to implement is dedicated to alleviation of poverty among a target group of our population. Poverty is defined as characteristic of individual groups relative to society as a whole. We may extend this to refer to characteristics of target groups in the Authority area relative to the more privileged groups or part of the country.[2] Poverty as a condition of such groups may be determined by primary, secondary or tertiary factors. The primary determinants may include such variables as food consumption, security, health or status. But the causes of poverty are far from simple, others reappear as secondary causes and others may be unique.[3]

The Fourth Development Plan lists five target groups such as pastoralists, small farmers, landless rural workers, urban poor and the handicapped. With the exception of the problem of pastoralists which may be limited to West Pokot, outside the core provinces, all the other target groups have emerged in the Authority area. The small farmers dominate the landscape of Nyanza and Western Provinces. In the more crowded districts of Kisii, Kisumu, Siaya and Kakamega, the problem of the landless rural workers is an important national challenge. Even the urban poor is already a serious development problem in the rapidly expanding major town of Kisumu and other smaller centres of growth.

---

2. Rodgers, G.B. Approaches to the Analysis of Poverty. World Employment Programme Research. Working Paper No. 71, page 9. ILO Geneva, May, 1979.

3. Rodgers, G.B. op.cit., p. 10-20

Given the demographic change outlined earlier, it is possible to see that the plight of the target groups in the Authority area will worsen unless measures are taken in planning meaningful educational programmes directed at the primary, secondary and tertiary causes of poverty in the area within the general framework of national development.

Within the framework of the Fourth Plan, Educational policy must be directed to reach the target group by making it more relevant to their needs and by a shift of attention from the quantitative aspects to a more diversified functional and improved system.[4]

However, poverty of the target groups in the area cannot be isolated from the general poverty conditions in the area and the effect of the overall national planning. Education can only be relevant if it enhances income earning opportunities, increases security of individuals, improves their health and enhances their status and participation in the shaping of their own destiny through the control of political power and control of utilization of resources. Such educational planning is inconsistent with an export oriented system generally regarded as unresponsive to local conditions.

The 13 point plan for the Authority functions share the common objective of the plan in alleviation of poverty through a more integrated regional planning process. The plan envisages massive support of co-ordinated research in resource use, improved performance of projects, the monitoring of the impact of resource use, important construction works, themselves dependent on intensive and extensive research, improved data base and rational development. Among the most important long-term objectives of the Authority, is a better knowledge of the effects of development of the area on Lake Victoria and the needs for the revision of resource use of the Lake within the context of international agreement.

It is clear from the national Development framework that the educational demands which the creation of the Authority now imposes on the educational resource allocation for the area are far in excess of the meagre resource of the nation and that a new framework capable of tapping international sources of support is required urgently.

---

4. Kenya Development Plan, 1979-1983. Part 1, p. 152 Government Printer, 1978.

It is a basic argument of this section of the paper that the provisions in the Development Plan for Educational services are out of step with the needs as reflected in the functions of the Authority and that a new system must be devised that would provide a rational base for research services in support of the specific and also the wider national aims which have led to the creation of the authority. The key to this is a restructuring of Higher Education and other tertiary forms of training to take account of the important development transformation and opportunities which the Lake Basin area provides.

VI. THE RATIONALE FOR DEVELOPMENT OF AN INSTITUTIONAL FRAMEWORK OF EDUCATIONAL SERVICES FOR DEVELOPMENT

As the dialogue on development models focuses more and more on integrated rural development and as the shift becomes more marked towards tackling the basic causes of rural poverty, the question that we need to ask ourselves in Kenya is the extent to which our educational services are being managed as an integral part of our spatial development strategy.

In this paper a critical attention has been given to the adverse effect of the export oriented model of development. It has been pointed out that in respect to the availability of manpower currently required for development, the Authority area is a deficit area. However, it is necessary to underline the positive advantages that the historical development policies have conferred on the area and which constitute demonstrable positive framework on which our planners can build.

From the selective resource development, the region has inherited an excellent transportation and road communication infrastructure that is rare in many developing countries. The most undeveloped aspects of resources are those that require the backing of large financial resources and high technology. Of particular importance are the water and power resources. Proper management of the water and power resources are a high priority in a situation where fossil fuels are becoming more and more beyond the reach of many nations. Water resources have been allowed to go to waste in a situation where population growth is increasing well beyond the capacity of the area to produce food.

Although facilities on the Kenya side do not compare with the Uganda side in generation of power, the region now depends on Uganda for power despite the existence of important prospects for small scale power development. The twentieth century will cleary see power as a major constraint to our development effort. But development of power could not be considered in isolation.

The other favourable effect of past development of the Authority area is a modest but vital network of urban centres linked up to the major focal point of Kisumu by an excellent network of high quality roads. These nodes and highways that link them form the skeleton urban infrastructure of great significance to development policy in the area.

The weakest aspect of this whole system is the educational infrastructure for development. This has stagnated largely because attention has not been effectively directed to education as an integral part of the spatial development process. It may be argued that the national institutions should cater for the additional needs.

In fact our University system has just grown and has only been casually related to the real issues of development at the rural end. The University institution has been an important instrument of canalising manpower to support an essentially urban based economy. The structure will increasingly become irrelevant to rural development as the extended lines of communication become prohibitively expensive.

The conclusion is that integrated regional development of which the establishment of the Authority is an example must be accompanied as a matter of national importance with a re-designing of the educational infrastructure. In this respect, it is suggested that as a matter of urgency, an institutional policy based on the development challenge of the area should be prepared as essential support services for the Authority's objectives.

It is only in this respect that we can create the multiplier effect for the research activities which will be generated. With the excellent road system in the area and adequate high level manpower, the Authority area could contribute significantly to our foreign exchange earning capacity.

CONCLUSION

The basic thrust of this paper is the importance of the Authority as an aspect of spatial development strategy. It is argued in this paper that the functions envisaged for the Authority go well beyond the capacity of regional and national manpower and material resources. The inadequacy of manpower can be rectified by a more realistic network of tertiary institutions to offset the imbalance which has tended to create an increasing pool of rural and urban poor in the area. The argument implicit in this paper is that a central University institution capable of adding its co-ordinating role to that of the Authority, and selected tertiary institutions are a must for the

eventual success of the spatial planning process. In the long run it is the development of the human resources and our capacity to sell our skills within and beyond Kenya that will determine the outcome of our uncertain fight against the creeping paralysis of rural and urban poverty.

EMPLOYMENT AND EARNINGS IN THE LAKE BASIN REGION: A STUDY IN REGION INCOME DISPARITY

By

Oyugi Aseto
Economics Department
University of Nairobi

INTRODUCTION

Since independence, the Kenya Government has continually enunciated its policy of promoting economic equality among persons and regions. This policy has been stated by political leaders through public pronouncements; the Government through official publication; and even by religious and other types of leaders. Thus, "bridging the income gap" is a theme that inundates debates in the Kenya Parliament and in the academia.

Yet, it appears that efforts to achieve this noble objective have not yielded the desired goal. Glaring regional inequalities still prevail. Patterns of economic activities inherited from the colonial period continue to flourish, with small modifications here and there. It is obvious that unless something drastic is done, statements aimed at attaining the goal of reducing income inequality among regions will remain empty words.

The purpose of this paper is to present a picture of the employment and incomes situation in the Lake basin region embracing Nyanza and the Western Provinces. In an effort to effect comparability with situations obtaining elsewhere in the country, the Rift Valley and the Central Provinces will be included in the analysis.

POPULATION OF THE REGION

According to the 1979 census, the population of the Nyanza and Western Provinces together constitute nearly one-third of the total Kenyan population. But it is the rate of population growth of the region that marks its outstanding feature. A study by the Population Studies Institute of the University of Nairobi, persons in the 0 - 14 years of age comprise almost 50 percent of the total population of each of the Provinces. Kisii and Kakamega Districts have registered the highest growth rates, being over 4 percent per year; this rate is higher than the national rate of 3.9 percent per annum./See Table I/

The significance of this rapid growth rate is that there is a corresponding rise in public and private expenditures to maintain and educate the youngsters. They have to be clothed, fed, housed and educated. But this age group is not yet economically productive. But when this group becomes of age and is economically productive, it poses the problem of oversupply of potential labour force and of consequential unemployment. Thus,these Provinces must be ready to deal with these problems.

By way of comparison, the Rift Valley Province and Nyanza Province have each about 3 million people. The Central Province has about 2 million and the Western Province about one million. Together, these make up about two thirds of the Kenyan population./See Table 1(b)/.

LABOUR FORCE IN THE REGION

A study by the Population Studies Institute of the University of Nairobi indicates that the total potential labour force of the region was 30.1 percent of the national one in 1969. This figure was projected to grow 31.2 percent in 1979 and to 32.6 percent in 1989. Nyanza Province, which in 1969 was only next to the Rift Valley in supplying potential labour force, is projected to lead all other Provinces in this score; it will comprise 20 percent of the national labour force by 1989. By comparison, the labour force of the Central Province is projected to constitute about 13.4 percent by that year, and the Rift Valley about 19.9 percent. While Table 2(a) presents the numerical magnitudes of the projected potential labour force for the years 1969, 1979 and 1989, Table 2(b) is a calculation of these data in percentages.

It is remarkable that the projected labour force composition for the years 1969 to 1989 varies with Provinces. While that of the Central Province is expected to grow very slowly from 13.0 percent in 1969 to 13.4 percent in 1989, that of Nyanza will register a change from 19.0 percent to 20.0 percent in the same period. The Western Province will record the fastest growth rate of the potential labour force: growing from 11.1% in 1969 to 12.6 percent in 1989.

Some Provinces are expected to register a decline in the relative supply of potential labour force. The Rift Valley Province, which recorded 20.7 percent of the total national labour force, is projected to record a decreased percentage of 19.9 by 1989. Similarly, the Eastern Province is expected to register a decline in potential labour supply from 16.8 percent in 1969 to 15.5 percent in 1989.

The picture that emerges is that the Lake Basin region, which comprises nearly a third of the total Kenyan population will, in future increase its percentage supply of potential labour force in relation to the rest of other regions in the country. The potential labour force in the region is not only growing the fastest, but is also continually added to by the increasing supply of the younger generation.

The implications of this situation are obvious enough. Employment in the modern sector must be created as the increasing population utilize the existing agricultural lands. No doubt, migration into urban areas will increasingly take place among these people, resulting in urban unemployment and congestion.

EMPLOYMENT IN THE REGION

Table 3(a) gives information on the employment in the Nyanza and Western Provinces. Total employment in the modern sector increased from 61,350 in 1967 to 94,743 in 1974; this represents an annual growth rate of employment of roughly 6.4 percent.

But further analysis of this picture reveals a variagated pattern of employment by industrial classification. While employment increased in some industrial concerns, it decreased remarkably in others. Employment in agriculture increased from 12,654 in 1967 to 22,764 in 1974, this recording an annual rate of increase of 8.7 percent. The agricultural industry, largely the sugarcane growing activities, has become increasingly intensified in the region. With the establishment of the South Nyanza Sugar Company, "SONY", the region has now been firmly established as the "Sugar-Belt" of Kenya, and has proved to be the biggest wage employer in the region. It is followed by the services industry, which represents the Government Services - all phases of civil service, local government, etc. Employment in this sector grew from 32,950 in 1967 to 51,960 in 1974; this representing an annual rate of growth of 6.7 percent. During the period, more than half of the people employed in the modern sector were engaged in the provision of services - such as teaching, civil service, local government service, etc.

The construction and commerce industries registered only marginal increases in employment during the period, recording an increase from 6,000 in 1967 to 7,000 in 1974. While construction industry increased its employment at an annual rate of 1.3 percent, the commercial activities increased

employment for the sector by 2.7 percent per annum. It is quite clear that not much construction work was carried out in the region during the period. Furthermore, commercial activities slackened down somewhat at the time. Perhaps the picture has now changed a little with Kisumu town being labelled "The Little Bombay" of Kenya.

Employment decreased in some industrial sectors during the period. In 1967, the transport and communications industry employed 3,215 people; this figure declined to 3,113 in 1974, representing a negative growth rate of .4 percent per annum. This means that activities relating to transportation declined or remained at a stand still. The mining and quarrying sector, which used to record brisk activities in the 1940's and 1950's, slowed down considerably; it registered employment of 158 in 1974, up from 619 in 1969; this being a negative growth rate of 17.7 percent annually.

It is important to relate these data to the national figures. Total employment in the Lake Region constituted 10.4 percent of the total national employment in 1967. This proportion rose to 11.5 percent in 1974. The biggest proportion in terms of national employment was the services sector, which constituted 15.9 percent in 1967 and 18.2 percent in 1974. The manufacturing sector recorded a fairly steady proportion of around 8 percent during the period. The commercial sector constituted roughly around 7 percent of the national total for each year during the period. The worst hit area was the mining sector, which recorded a declining proportion from 25.6 percent in 1967 to 4.1 percent in 1974.

These data have a message to deliver. They reveal the extent to which the region does not equitably share in employment in the modern sector. While the total labour force in the region is about 30 percent of the total, only 11.5 percent of the national total employment in the modern sector is employed in the region. And the largest share goes largely to the employment in the services sector.

Table 3(b) is presented for comparison with the Rift Valley and the Central Provinces. The proportions in these Provinces are much higher for almost all industrial sectors. For example, employment in agriculture is much higher in the Rift Valley and Central Provinces, these constituting national proportions of 56.2% and 23.2%, respectively, in 1967; these figures being, respectively, 49.3 percent and 27.2 percent in these Provinces in 1974.

During the period, more people were employed in the services sector in the Rift Valley Province alone than in the Nyanza and Western Provinces. The Central Province alone employed a number of people which almost equalled those employed in the Lake Basin region in 1974.

This analysis implies that employment in the Provinces do not reflect the available labour force in the corresponding Provinces. Some Provinces are more represented in some industrial sectors than others, suggesting inequality in the distribution of employment opportunities.

EARNINGS IN THE REGION

Table 4(a) presents data of earnings in the modern sector by Districts and Provinces in Kenya from 1966 to 1977, while Table 4(b) breaks down these figures into percentages.

As in the case of employment, earnings also reflect disproportional share by the Nyanza and Western Provinces in the national total earnings in the modern sector. In 1966, Nyanza Province earned 5.5 percent of the total national earnings. This rose to 5.7 percent in 1972 and to 7.1 percent by 1977. In the same years, the figures for the Western Province were 2.2 percent, 2.7 percent, and 4.2 percent. These figures constituted a combined total percentage of the two Provinces of 7.7, 8.4, and 11.3, for the years 1966, 1972 and 1977, respectively.

By way of comparison, combined total earnings of the Central Province alone in 1966 was higher than that of both of the Lake Basin Provinces together, the former being 9.9 percent and the latter 7.7 percent. The situation had not changed much by 1977: the two Provinces together registered total earnings of 11.3 percent which was almost equal to the Central Province share of the national total of 11.0 percent. The Rift Valley Province has continued to maintain its large share at constant proportion of 14.6 percent in 1966 and 14.5 percent in 1977.

It is quite clear that the share of the national earnings by various Provinces do not reflect the natural and human resource endowments of the respective Provinces. This disproportional share in the earnings reflect, largely, the unequal employment opportunities among Provinces. Employment levels and patterns are again a reflection of the industrial establishments and patterns of investments, both public and private. While public investments indicate the degree of interest of the Government in the region - linking political power with economic activity - private investments show the degree

of confidence which the money-lenders, mainly the banks, have in the region. In addition, it also shows the degree of confidence of the business sector in the area. Thus, it is evident that the earnings of a region depend on a chain of links between politics, business, and economics.

CONCLUSIONS

(1) From the previous papers presented during the workshop, it is clear that the region is well endowed with abundant natural and human resources. The area comprises nearly one-third of the Kenyan population, with a corresponding one-third of the potential labour force of the nation. Yet it is clear that the utilization of these natural and human resources is far from being satisfactory. There is a tremendous amount of waste of human resources in the region, since only one-fifth of these resources is employed in the modern sector.

(2) Part of the problem is that the region suffers from lack of establishment of modern industrial concerns. As compared with other regions with comparative natural endowment, the region lags far behind. Rather than being a producer of industrial commodities, the region is a consumer of products made elsewhere. Of course, there have been efforts to produce sugar - the region is called "Sugar-belt" of Kenya - these attempts have run into trouble as there have been lack of sufficient factories to process the sugar cane. There has emerged a general complaint that sugar cane is being "over-produced" and people who want to establish factories in order to crash the sugar-cane have been warned by the Government not to do so. No more land is to be used to grow the sugarcane unless authorized. Thus, the region is experiencing a serious condition of unemployment, especially among the youth and the educated.

(3) The region is extremely poorly represented in almost all sectors of economic activities; this situation indicates the corresponding meagre employment registered in the region. It is expected that the recent impetus given to the development of agricultural produce may generate activities in other industrial sectors through linkage and spread effects.

(4) Earnings in the region also are very meagre relative to those in other Provinces. This situation demonstrates the extent and seriousness of income inequality among Kenya's Provinces. The region lags behind other comparable regions in terms of its earnings.

RECOMMENDATIONS.

(1) It is important to start a crash economic development programme for the regions if these anomalous situations are to be rectified. Thus, the Government, which is already committed to the economic development of the region by establishing the Lake Basin Development Authority, should now undertake massive investment projects in the region. Such investments should be a mixture of public and private ventures.

(2) Loan programmes, aimed at boosting commercial activities, should be instituted, so that people in the region could have ready access to credits at reasonable borrowing terms.

(3) Roads should be improved and new ones built so that rural people could have ready access to rural markets. This access enables traders to engage in economic activities.

(4) Since agriculture is the mainstay of the people presiding in the region, agricultural produce and terms of their trade should be improved. Thus, cotton growers should have ready access to credits for cotton production, and they should be paid immediately they sell their product. There have been delays of up to a year or more between the time the cotton is sold to the co-operative societies and the time payment is received.

(5) Full-employment should be set as the goal of the region, and vigorous efforts should be made pursue this goal.

Table (1a) PERCENTAGE POPULATION PROJECTION 1969, 1979

	1969				1979		
	Age Group	Male	Females	Both Sexes	Males	Females	Both Sexes
Kenya	0-4	19.6	19.4	19.5	19.5	19.1	19.3
	5-9	14.4	15.4	15.4	15.4	15.2	15.3
	10-14	12.7	12.6	12.7	12.8	12.5	12.6
	15-19	10.6	10.5	10.5	10.6	10.4	10.5
	20-24	8.7	8.5	8.6	8.9	8.6	8.8
	25-29	7.0	6.9	6.9	7.2	7.0	7.1
	30-34	6.0	5.9	6.0	6.1	5.9	6.0
	35-39	4.4	4.3	4.4	4.7	4.6	4.6
	40-44	4.0	3.8	3.9	3.9	3.9	3.9
	45-49	2.9	3.0	3.0	3.0	3.2	3.1
	50-54	2.3	2.2	2.3	2.4	2.4	2.4
	55-59	2.1	2.4	2.3	2.0	2.3	2.1
	60+	4.1	5.0	4.6	3.8	4.8	4.3
	TOTALS	100	100	100	100	100	100
Coast Province	0-4	17.0	17.7	17.3	16.4	16.8	16.6
	5-9	13.8	14.4	14.1	13.4	13.8	13.6
	10-14	10.7	10.7	10.7	11.2	11.0	11.1
	15-19	9.9	10.8	10.3	10.0	10.4	10.2
	20-24	9.0	9.6	9.3	8.9	9.2	9.0
	25-29	9.0	8.5	8.7	8.1	8.0	8.1
	30-34	7.8	7.1	7.4	6.9	6.8	6.9
	35-39	5.9	5.1	5.5	5.7	5.3	5.5
	40-44	4.8	4.1	4.4	4.8	4.4	4.6
	45-49	3.3	3.1	3.2	3.8	3.5	3.6
	50-54	2.6	2.2	2.4	3.1	2.8	2.9
	55-59	2.2	2.3	2.5	2.5	2.6	2.6
	60+	4.2	4.5	4.4	5.1	5.7	5.2
	TOTALS	100	100	100	100	100	100
Central Province	0-4	23.3	21.6	22.4	23.7	22.2	22.9
	5-9	17.0	16.0	16.7	17.6	16.5	17.0
	10-14	12.0	11.2	11.6	13.0	11.9	12.5
	15-19	9.9	9.2	9.6	10.4	9.6	10.0
	20-24	7.9	7.8	7.9	8.1	7.9	8.0
	25-29	6.0	6.0	6.0	6.2	6.1	6.2
	30-34	5.0	5.2	5.1	5.0	5.1	5.0
	35-39	3.6	3.8	3.7	3.7	3.8	3.8
	40-44	3.3	3.7	3.5	3.1	3.5	3.3
	45-49	2.5	3.1	2.8	2.3	2.9	2.6
	50-54	2.1	2.4	2.2	1.8	2.2	2.0
	55-59	2.2	2.9	2.6	1.6	2.5	2.1
	60+	5.1	6.9	6.0	3.4	5.7	4.6
	TOTALS	100	100	100	100	100	100
Eastern Province	0-4	20.5	19.1	19.7	21.4	19.5	20.3
	5-9	16.3	15.2	15.7	16.8	15.5	16.0
	10-14	13.3	12.5	12.9	13.4	12.7	13.0
	15-19	10.9	10.3	10.6	10.9	10.8	10.6
	20-24	7.8	8.0	7.9	8.2	8.1	8.1
	25-29	6.1	6.7	6.4	6.4	6.7	6.6
	30-34	5.3	5.7	5.5	5.3	5.6	5.4
	35-39	3.9	4.2	4.1	4.1	4.2	4.1
	40-44	3.8	4.2	4.0	3.6	4.0	3.8
	45-49	2.9	3.4	3.2	2.7	3.3	3.0
	50-54	2.3	2.4	2.3	2.1	2.3	2.2
	55-59	2.2	2.6	2.4	1.8	2.4	2.1
	60+	4.6	5.9	5.3	3.6	5.4	4.5
	TOTALS	100	100	100	100	100	100

Table 1a (contd.) PERCENTAGE POPULATION PROJECTION 1969, 1979

		1969			1979		
	Age Group	Males	Females	Both Sexes	Males	Females	Both Sexes
Nairobi	0-4	12.6	18.7	15.1	12.6	18.7	15.2
	5-9	8.6	13.4	10.5	8.6	13.4	10.6
	10-14	6.1	10.6	7.9	6.1	10.6	8.0
	15-19	8.2	12.8	10.0	8.2	12.8	10.1
	20-24	15.6	14.3	15.1	15.6	14.3	15.1
	25-29	13.4	9.3	11.7	13.4	9.3	11.7
	30-34	11.4	6.8	9.6	11.4	6.8	9.5
	35-39	8.1	4.0	6.5	8.1	4.0	6.4
	40-44	6.2	3.2	5.0	6.2	3.2	5.0
	45-49	3.9	2.1	3.2	3.9	2.1	3.2
	50-54	2.5	1.4	2.1	2.5	1.4	2.1
	55-59	1.6	1.3	1.5	1.6	1.3	1.5
	60+	1.7	2.0	1.8	1.7	2.0	1.8
	TOTALS	100	100	100	100	100	100
North Eastern Prov.	0-4	14.6	15.1	14.8	14.6	15.1	14.8
	5-9	14.6	15.0	14.8	14.6	15.0	14.8
	10-14	15.3	15.4	15.3	15.3	15.4	15.3
	15-19	13.4	12.1	12.8	13.4	12.1	12.8
	20-24	11.2	9.4	10.3	11.2	9.4	10.3
	25-29	7.4	7.1	7.3	7.4	7.1	7.3
	30-34	6.4	6.7	6.5	6.4	6.7	6.5
	35-39	4.4	4.8	4.6	4.4	4.8	4.6
	40-44	3.8	3.8	3.8	3.8	3.8	3.8
	45-49	2.6	2.8	2.7	2.6	2.8	2.7
	50-54	2.0	2.2	2.0	2.0	2.2	2.0
	55-59	1.6	2.2	1.9	1.6	2.2	1.9
	60+	2.8	3.6	3.1	2.8	3.6	3.1
	TOTALS	100	100	100	100	100	100
Nyanza Province	0-4	19.7	18.7	19.2	19.7	18.7	19.2
	5-9	16.2	15.4	15.8	16.2	15.4	15.8
	10-14	14.5	13.7	14.1	14.5	13.8	14.1
	15-19	11.2	10.6	10.9	11.2	10.6	10.9
	20-24	8.2	8.1	8.0	8.2	8.1	8.1
	25-29	6.0	6.7	6.3	6.0	6.7	6.4
	30-34	5.4	6.2	5.8	5.4	6.2	5.8
	35-39	4.0	4.6	4.3	4.0	4.6	4.3
	40-44	3.7	4.0	3.8	3.7	4.0	3.8
	45-49	2.8	3.1	3.0	2.8	3.1	3.0
	50-54	2.3	2.3	2.3	2.3	2.3	2.3
	55-59	2.5	2.3	2.2	2.1	2.3	2.2
	60+	3.9	4.1	4.0	3.9	4.1	4.0
	TOTALS	100	100	100	100	100	100
Rift Valley Prov.	0-4	18.5	19.4	19.0	17.5	17.1	17.3
	5-9	15.0	15.9	15.4	14.4	14.1	14.3
	10-14	12.3	12.8	12.5	12.2	12.0	12.1
	15-19	10.5	10.7	10.6	10.4	10.2	10.3
	20-24	8.8	9.0	8.9	8.8	8.7	8.7
	25-29	8.0	7.3	7.7	7.4	7.4	7.4
	30-34	6.5	5.9	6.2	6.2	6.2	6.2
	35-39	4.7	4.1	4.5	5.2	5.2	5.2
	40-44	4.3	3.6	3.9	4.3	4.4	4.4
	45-49	3.1	2.8	2.9	3.6	3.7	3.6
	50-54	2.3	1.9	2.1	2.9	3.0	3.0
	55-59	2.0	2.1	2.1	2.3	2.5	2.4
	60+	4.0	4.5	4.2	4.9	5.5	5.2
	TOTALS	100	100	100	100	100	100

...../3

Table 1a (contd.) PERCENTAGE POPULATION PROJECTION 1969, 1979

		1969			1979		
	Age Group	Male	Female	Both Sexes	Male	Female	Both Sexes
Western Province							
	0-4	21.9	20.1	21.0	21.4	20.7	20.9
	5-9	16.7	15.6	16.1	16.5	16.0	16.2
	10-14	15.0	14.2	14.6	13.4	13.1	13.3
	15-16	11.3	10.7	11.0	10.8	10.6	10.7
	20-24	7.3	7.5	7.4	8.5	8.5	8.5
	25-29	5.0	5.9	5.5	6.8	6.8	6.8
	30-34	4.7	5.7	5.2	5.5	5.6	5.6
	35-39	3.5	4.3	3.9	4.3	4.5	4.4
	40-44	3.3	3.6	3.5	3.5	3.6	3.5
	45-49	2.6	2.9	2.7	2.7	2.9	2.8
	50-54	2.1	2.3	2.2	2.1	2.3	2.2
	55-59	2.1	2.6	2.3	1.6	1.8	1.7
	60+	4.5	4.7	4.6	3.0	3.5	3.3
	TOTALS	100	100	100	100	100	100

Table 2(a) LABOUR FORCE: AGED 15 - 59

	1969			1979			1989		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Central Province	345805	382606	723411	473378	522258	995636	675429	745174	1420603
Eastern Province	418183	463304	881487	564176	625697	1189873	781567	866795	1648362
Nyanza Province	478845	515443	994288	694034	747255	1441289	1001076	1077844	2078920
Western Province	268521	312443	580964	430455	469740	900195	639642	698016	1337658
Rift Valley Province	573090	508395	1081485	797503	752900	155043	1093612	1021513	2115125
TOTAL KENYA	2632992	2599394	5232386	3764487	3724255	7488742	5342131	5269092	10611223

Table 2(b) PERCENTAGE LABOUR FORCE: AGED 15 - 59

	1969			1979			1989		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Central Province	13.1	14.7	13.9	12.6	14.0	13.3	12.6	14.1	13.4
Eastern Province	15.9	17.8	16.8	15.0	16.8	15.9	14.6	16.5	15.5
Nyanza Province	18.2	19.8	19.0	18.4	20.1	19.2	18.7	20.5	20.0
Western Province	10.2	12.0	11.1	11.4	12.6	12.0	12.0	13.2	12.6
Rift Valley Province	21.8	19.6	20.7	21.2	20.2	2.1	20.5	19.4	19.9

Table 3(a) WAGE EMPLOYMENT IN NYANZA AND WESTERN PROVINCES BY INDUSTRY IN SELECTED YEARS

	1967	1969	1972	1974	Annual Growth Rate 1967 - 74	% proportion of National for the sec. 1967	1969	1972	1974
Agriculture	12654	10687	16163	22764	8.7	6.6	5.4	6.5	8.7
Mining	619	648	246	158	-17.7	25.6	25.1	7.7	4.1
Manufacturing	5467	6701	6452	8186	5.9	8.0	9.2	7.6	8.1
Construction	2882	3049	2937	3159	1.3	9.6	10.6	7.8	7.1
Electricity & Water	234	288	438	316	4.2	4.3	5.6	8.4	5.5
Commerce	3329	3376	2973	4012	2.7	7.2	7.7	8.3	7.0
Transport & Communi-cations	3215	3840	2068	3113	-0.4	6.9	7.4	4.6	6.8
Services	32950	35894	41723	51960	6.7	15.9	15.8	18.0	18.2
Total Employment	61350	64483	73653	94743	6.4	10.4	10.3	10.3	11.5

Source: These figures are obtained from various issues of the Statistical Abstract published by the Government of Kenya.

Table 3b WAGE EMPLOYMENT BY PROVINCE AND INDUSTRY IN RIFT VALLEY AND CENTRAL PROVINCE

	1967	1969	1972	1974	Annual % Growth Rate	% Share of National Total 1967	1969	1972	1974
Agriculture & Forestry:									
Rift Valley Province	106819	112536	133475	128820	2.7	56.2	57.7	54.1	49.3
Central Province	44075	45331	62259	70914	7.0	23.2	23.2	25.2	27.2
Mining and Quarrying:									
Rift Valley Province	699	716	1078	1372	110.1	28.9	27.7	34.0	35.5
Central Province	93	48	26	10	-273.0	3.8	1.9	0.8	0.3
Manufacturing:									
Rift Valley Province	10096	10318	12044	14289	5.0	14.8	14.2	14.2	14.1
Central Province	8679	9448	12019	14650	7.7	12.7	13.0	14.2	14.5
Construction:									
Rift Valley Province	4567	2500	5245	5264	2.0	15.3	8.6	13.9	11.8
Central Province	1375	1795	3942	3391	113.8	4.6	6.2	10.5	7.6
Electricity & Water									
Rift Valley Province	696	626	507	546	-3.4	12.6	12.1	9.8	9.6
Central Province	819	475	215	584	-6.3	14.7	9.2	4.2	10.3
Commerce:									
Rift Valley Province	5483	5501	6311	7402	4.3	11.8	12.5	13.2	13.0
Central Province	2246	2155	4241	4526	105.3	4.8	4.9	8.9	9.3
Transport and Communication:									
Rift Valley Province	4292	5670	2785	2389	-8.0	9.2	10.9	6.1	5.2
Central Province	1510	1719	910	1558	0.45	3.2	3.3	2.0	3.4
Services:									
Rift Valley Province	35274	41079	34465	49996	5.1	16.9	18.1	19.4	22.6
Central Province	29037	32829	32623	37602	3.8	13.9	14.5	17.7	18.0
Total Wage Employment:									
Rift Valley Province	167926	178949	195885	208178	3.1	28.1	28.5	27.2	25.1
Central Province	87838	95800	116269	133235	6.1	14.7	15.0	16.2	16.1

Source: These figures are obtained from various issues of the Statistical Abstract published by the Government of Kenya.

Table 4(a)

EARNINGS BY PROVINCE AND DISTRICT 1966 - 1977

K£000

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Nairobi	60977.0	71819.3	73058.2	72503.6	73510.1	88160.4	97062.4	105149.5	123068.5	141425.6	166428.3	184160.5
Kiambu	7096.0	5631.0	6077.6	6880.7	7560.5	9194.5	9466.3	11742.4	13524.2	14911.1	18265.2	21380.9
Muranga	1593.0	1365.1	1951.5	2144.2	3317.1	4559.7	3320.5	3637.1	4700.4	5008.4	6174.6	7427.0
Nyeri	2305.0	2327.6	2849.1	3038.2	3578.3	3669.9	4407.6	4735.1	5966.1	7094.9	11607.2	12110.8
Kirinyaga	445.0	394.0	544.7	580.0	725.0	1226.6	1438.4	1642.2	1777.5	2195.1	2689.0	3083.3
Nyandarua	847.0	1034.0	1240.5	1384.6	1678.4	2022.4	2356.4	1881.8	2313.4	2298.7	3074.6	3548.9
TOTAL	12286.0	10751.7	12663.4	13947.7	16859.3	20672.8	20989.2	23638.6	28281.6	31508.2	41810.6	47550.9
Kisumu	-	4635.2	4799.4	5276.0	6883.2	6665.8	6700.7	6802.7	9369.0	9990.9	12379.1	13927.4
Siaya	4784.0	112.0	64.3	105.3	148.5	298.3	636.2	972.8	1580.4	1309.7	1703.3	1968.0
South Nyanza	964.0	716.6	1150.9	1221.5	1621.2	1718.2	1657.7	1975.4	2918.9	3065.6	3635.4	8008.3
Kisii	1204.0	789.2	955.1	1169.9	1747.1	1952.2	2707.1	3025.1	4383.9	4787.6	6167.8	6764.6
TOTAL	6952.0	6253.0	6969.7	7772.7	10400.0	10634.5	11701.7	12776.0	18252.2	19153.8	23785.6	30668.3
Kakamega	1559.0	1912.4	2034.8	2466.0	2619.0	2988.2	3359.2	4324.4	5934.0	6577.4	8623.7	10919.4
Bungoma	925.0	575.5	851.0	951.3	1123.0	1186.9	1685.1	2207.7	2942.2	3560.1	4247.0	5551.8
Busia	318.0	286.3	435.6	503.7	653.0	656.6	621.1	808.9	802.7	1216.0	1492.7	1641.3
TOTAL	2802.0	2774.2	3321.4	3921.0	4395.0	4831.6	5665.5	7431.0	9678.9	11353.5	14363.4	18112.5
Mombasa	16241.7	118061.3	18542.8	18535.5	18531.4	20844.0	21722.5	25858.2	31152.1	35705.4	41552.1	47259.9
Kilifi	751.0	625.3	899.0	1040.2	1181.1	1321.4	1721.5	1976.6	2384.1	2998.2	3734.2	3818.7
Kwale	389.0	949.7	992.4	1173.4	1383.9	1460.8	1226.1	1294.8	1579.9	1753.1	2158.2	2633.9
Lamu	104.0	121.1	131.5	143.3	164.9	108.0	257.6	288.8	357.4	451.4	653.2	748.4
Tana River	114.0	119.0	153.1	191.8	211.7	236.9	270.5	334.9	476.2	498.3	525.5	754.9
Taita Taveta	1148.0	900.0	1160.1	1216.9	1400.3	1573.9	1362.3	1665.5	2029.5	2147.8	2570.9	2750.7
TOTAL	18747.7	20776.4	21878.9	22301.1	22873.3	25617.0	26560.5	31418.8	37969.2	43554.2	51294.1	57966.4
Laikipia	1176.0	1147.6	1312.4	1675.4	1827.9	2127.5	1811.8	1973.5	2151.9	2151.7	3243.7	4023.3
Narok	167.0	220.8	262.7	285.5	350.3	441.9	450.0	471.8	687.8	667.4	922.0	1048.5
Kajiado	475.0	549.4	571.9	597.9	624.6	897.6	1023.8	1362.8	1439.6	1770.5	2065.9	2303.0
Turkana	167.0	107.7	183.9	173.6	183.5	195.1	240.6	280.7	386.2	422.8	558.5	711.4
Samburu	88.0	116.6	207.6	240.9	267.2	307.5	277.0	291.2	394.3	425.7	554.9	708.5
Nakuru	6693.0	6362.9	6826.1	7347.0	8576.9	3063.6	10419.6	12668.2	13540.2	15821.8	18275.0	20672.2
Baringo	198.0	241.0	352.0	359.4	414.0	412.4	623.1	719.6	985.0	1218.6	1804.3	1866.2
Kericho	3295.0	3673.3	3827.2	4311.5	4905.3	5158.5	6090.0	6418.4	6891.5	7959.4	10282.6	11202.7
Uasin Gishu	3220.0	3312.2	3149.7	3571.8	3923.4	4183.2	4220.6	4635.4	4906.4	5552.8	6560.9	7841.8

NYANZA Cont.	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Kisumu Municipality	4436	4644	4881	5114	5453	5622	5570	5602	5949	6175	6190	6304
South Nyanza	41952	45684	50986	45637	60351	59758	56238	58038	152089	151880	130848	147450
Siaya	-	-	-	46193	48213	50648	64980	65654	99895	106973	104820	106095
TOTAL	191337	196821	221138	206462	234912	248990	269764	291128	562511	602695	550580	554450
RIFT VALLEY:												
Baringo	27202	34070	37166	38288	12244	13235	17149	19372	32196	36914	38329	44405
Nakuru	-	-	-	-	30396	36196	41532	47496	69795	77168	83657	87232
Nakuru Municipality	5452	5915	6170	7101	7489	8069	8633	10707	13697	14219	16055	15491
Kipsigis	42553	45127	47734	52007	53344	56526	54423	61941	107788	114297	130248	130670
Laikipia	6198	7382	6936	7602	7981	9918	11868	13209	17846	19236	20470	22264
Narok	4516	4935	5266	7101	5965	6859	8275	8433	12832	15494	15810	16935
Olkejuado	5125	5637	6062	6790	7627	9153	10458	11232	14662	15641	17101	19229
Samburu	1427	1736	1844	2204	2079	2724	3241	3370	4160	3970	4464	4468
Elgeyo Marakwet	51212	59342	62005	62289	11673	13913	15482	17294	29086	32234	33925	33264
Nandi	-	-	-	-	23272	26207	28800	30455	55283	59960	61489	63442
Trans Nzoia	-	-	-	-	11956	13414	15672	17394	34416	38311	39050	42963
Uasin Gishu	-	-	-	-	18078	19800	21581	22398	39935	43929	47071	50948
West Pokot	-	-	-	-	3036	4469	6019	6469	10445	10823	11820	13418
Turkana	1215	1181	1414	1065	1409	1500	2286	2863	4236	3491	3340	3610
Eldoret Munic.	-	-	-	-	3113	4147	3094	3853	3891	4158	4503	4695
Kitale Munic.	-	-	-	-	3330	2667	2462	2633	3917	4854	4314	3699
TOTAL	144902	165325	174597	183233	202992	228797	250975	279119	454185	495699	530646	556948
WESTERN:												
Bungoma	37340	44273	42672	56125	58398	56398	62696	64740	111847	116253	114622	122270
Busia	17882	18331	19821	20286	27813	24270	28273	29906	53194	57032	56404	57102
Kakamega	84739	87666	83439	93519	115576	119501	143931	151201	236434	257974	275159	267909
TOTAL	139961	150270	145932	169930	201787	200708	234900	245847	401475	431259	446185	447281
NATIONAL TOTAL	1043416	1133179	1209608	1282297	1427589	1525498	1675919	1816017	2705878	2881155	2894617	2974849

Note: + Prior to 1969 Marsabit was counted with Isiolo.
+ Prior to 1969 Siaya was counted with Kisumu.

Table 4(b) PERCENTAGE EARNINGS BY PROVINCE AND DISTRICT 1966-1977

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Nairobi	48.5	52.7	50.6	48.3	45.4	47.5	46.9	45.5	44.9	45.3	43.8	42.7
Kiambu	5.6	4.1	4.2	4.9	4.7	5.0	4.6	5.1	4.9	4.8	4.8	5.0
Muranga	1.3	1.0	1.4	1.4	2.0	2.5	1.6	1.6	1.7	1.6	1.6	1.7
Nyeri	1.8	1.7	2.0	2.0	2.2	2.0	2.1	2.0	2.2	2.3	3.1	2.8
Kirinyaga	0.4	0.3	0.4	0.4	0.4	0.7	0.7	0.7	0.6	0.7	0.7	0.7
Nyandarua	0.7	0.8	0.9	0.9	1.0	1.1	1.1	0.8	0.8	0.7	0.8	0.8
TOTAL	9.9	7.9	8.8	9.3	10.4	11.1	10.1	10.2	10.3	10.1	11.0	11.0
Kisumu	-	3.4	3.3	3.5	4.2	3.6	3.2	2.9	3.4	3.2	3.3	3.2
Siaya	3.8	0.1	0.4	0.1	0.1	0.2	0.3	0.4	0.6	0.4	0.4	0.5
South Nyanza	0.8	0.5	0.8	0.8	1.0	0.9	0.8	0.9	1.1	1.0	0.9	1.9
Kisii	1.0	0.6	0.7	0.8	1.1	1.1	1.3	1.3	1.6	1.5	1.6	1.6
TOTAL	5.5	4.6	4.8	5.2	6.4	5.7	5.7	5.5	6.7	6.1	6.3	7.1
Kakamega	1.2	1.4	1.4	1.6	1.6	1.6	1.6	1.9	2.2	2.1	2.3	2.5
Bungoma	0.7	0.4	0.6	0.6	0.7	0.6	0.8	1.0	1.1	1.1	1.1	1.3
Busia	0.3	0.2	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.4	0.4	0.4
TOTAL	12.2	2.0	2.3	2.6	2.7	2.6	2.7	0.3	3.5	3.6	3.8	4.2
Mombasa	12.9	86.6	12.9	12.4	11.4	11.2	10.5	11.2	11.4	11.4	10.9	11.0
Kilifi	0.6	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	1.0	1.0	0.9
Kwale	0.3	0.7	0.6	0.8	0.9	0.8	0.6	0.6	0.6	0.6	0.7	0.6
Lamu	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Tana River	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2
Taita Taveta	0.9	0.7	0.8	0.8	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.6
TOTAL	14.9	15.2	15.2	14.9	14.1	13.8	12.8	13.6	13.8	13.9	13.5	13.4
Laikipia	0.9	0.8	0.9	1.1	1.1	1.1	0.9	0.9	0.8	0.7	0.9	0.9
Narok	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2
Kajiado	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.6	0.5	0.7	0.5	0.5
Turkana	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
Samburu	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2
Nakuru	5.3	4.7	4.7	4.9	5.3	1.7	5.0	5.5	4.9	5.1	4.8	4.8
Baringo	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.4	0.5	0.4
Kericho	2.6	2.7	2.7	2.9	3.0	2.8	2.9	2.8	2.5	2.5	2.7	2.6

Table 4(b) contd.

PERCENTAGE EARNINGS BY PROVINCE AND DISTRICT 1966-1977

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Uasin Gishu	2.6	2.4	2.2	2.4	2.4	2.3	2.0	2.0	1.8	1.8	1.7	1.8
Nandi	0.8	0.9	0.9	1.0	1.1	1.1	1.3	1.1	1.1	1.2	1.1	1.1
Trans Nzoia	1.3	1.1	1.2	1.4	1.7	1.6	1.5	1.3	1.1	1.2	1.3	1.3
Elgeyo Marakwet	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
West Pokot	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
TOTAL	14.6	13.7	13.9	15.1	16.1	14.8	15.3	15.3	14.2	14.4	14.6	14.5
Embu	0.4	0.3	0.5	0.5	0.5	0.5	1.2	1.1	0.9	0.9	1.2	1.2
Meru	1.1	1.0	1.2	1.3	1.3	1.1	1.6	1.7	1.8	1.7	1.7	1.9
Isiolo	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Kitui	0.3	0.3	0.3	0.3	0.4	0.3	0.5	0.6	0.6	0.6	0.6	0.7
Machakos	2.0	1.6	1.6	1.7	1.8	1.7	2.3	2.5	2.6	2.4	2.5	2.5
Marsabit	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TOTAL	4.0	3.5	4.0	4.2	4.4	3.9	6.0	6.3	6.2	5.9	6.4	6.6
Garissa	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Wajir	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1	0.2
Elwak	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.7	0.6	0.6
ALL PROVINCES	100	100	100	100	100	100	100	100	100	100	100	100

WATER RESOURCES OF LAKE VICTORIA DRAINAGE BASIN IN KENYA

By

GEORGE S. ONGWENYI

PHYSICAL BACKGROUND

The Lake Victoria drainage basin as shown in Table 1 forms part of a well-watered lacustrine environment which extends into Uganda and Tanzania with contributions from Ruanda and Burundi covering a total basin area of about 266,000 km^2 of which the lake area constitutes about 68,000 km^2 while the Islands and the main land contribute an area of 3,000 km^2 and 195,000 km^2 respectively. In other words, the lake area accounts for about 27 per cent of the total basin area while the Islands and the main land account for 1 per cent and 72 per cent, respectively of the total basin area covering the five countries. Of these as shown in Table 1, Kenyan Lake area is about 4,000 km^2 at an elevation of 900 m while the main land and Islands within the Republic of Kenya cover an area of about 45,000 km^2 accounting for 8.4 per cent of total area of Kenya.

Table 1: The distribution of Lake Victoria drainage basin by country

COUNTRY	LAKE AREA (KM^2)	LAND AREA INCLUDING ISLANDS KM^2	TOTAL AREA NEAREST 1000 KM^2
Kenya	4,000	45,000	49,000
Tanzania	35,000	86,000	121,000
Uganda	29,000	33,000	62,000
Ruanda	-	34,000	34,000
Burundi	-	-	-

Source:

This drainage basin embraces the plateau country sloping westwards from the highlands that border the central Rift of Kenya. This plateau country is further subdivided into two parts north and south of the gulf by the Nyanza Rift. The elevation and hence the relief of the basin vary considerably from the eastern slopes of Mount Elgon and the undulating highland country lying between 1800 m and 2800 to the relatively low-lying land at about 1100 m around

the shore of Lake Victoria.

The contrast in elevation is also reflected in the pattern of rainfall (see Fig. 1) in that although the Lake Victoria Basin receives a good rainfall, well distributed over the area (showing a consistency of rainfall from the watershed of the catchment to the outfall of the river systems feeding this catchment) it is marked by a variation from about 750 mm in the warmer and low lying areas around the lake shore to well over 1800 mm in the higher sides of Gusii, Kericho, and Kakamega including the slopes of Mt. Elgon and the Nandi Hills from where the perennial rivers feeding Lake Victoria drainage system originate.

The number of rainfall stations operated within the Lake Victoria drainage basin is shown in Table 2 while the monthly and annual rainfall at selected stations is shown in Table 3. Data in Table 3 rises question of the spatial representativeness of the rainfall stations operated in each basin.

Table 2: Rainfall stations operated within the Lake Victoria

River Basin	DRAINAGE AREA Area Km^2	Number of Stations
IA Sio (Malakisi)	2326	24
IB Itobus (Nzoia)	5478	50
IC Sosiani (Kipkarrea)	2735	59
IE Nzoia	2497	25
IF Yala	3262	35
IG Nyando	3450	71
IH Kibos	49929	64
IJ Sondu	3489	39
IK Gucha	6868	34
IL Mara	8941	16
ID Malaba - Koiya (Nzoia)	1986	12
TOTAL	46024	409

Source:

The lake shore areas show a minimum expectation of about 500 mm to 900 mm in nineteen years out of twenty and this presents problems of land use to the people in comparison with the higher and wetter areas where the minimum expectation is of the order of 1300 mm or more in nineteen years out of twenty.

Table 3: Monthly and annual rainfall at selected stations in the Lake Victoria drainage system

Month	Kisumu (MM)	Kericho (MM)	Kisii (MM)
January	52.97	79.28	60.10
February	84.55	95.05	93.67
March	138.53	165.90	182.95
April	185.80	247.53	256.02
May	145.55	223.60	137.90
June	75.05	113.53	102.17
August	73.15	139.05	150.70
September	60.10	118.50	160.87
October	53.40	112.62	145.22
November	91.45	117.42	145.50
December	95.70	109.78	117.42
	1093.20	1658.78	1762.42

Rainfall reliability analysis carried out at Ahero on the Kano plains are shown in Table 4. From that Table it is evident that for example, the rainfall in June will probably be less than 1.2 inches, ten times in one hundred years.

Table 4: Rainfall reliability analysis at ahero.

Month	Percentage change of obtaining less than the value indicated			
	10%	30%	50%	95%
January	0	0.3	0.7	5.2
February	0	1.4	2.5	7.7
March	1.6	3.9	5.5	10.4
April	2.7	5.0	6.8	14.9
May	2.2	4.5	6.4	15.1
June	1.2	2.3	3.1	5.5
July	0.6	1.6	2.5	5.8
August	1.6	2.8	3.7	6.4
September	0.9	1.7	2.5	4.6
October	0.7	1.3	2.0	7.0
November	1.1	2.1	2.9	6.7
December	0.5	1.5	2.4	6.7
Annual	32.3	38.4	42.0	54.7

Table 5: Surface runoff within catchments of Lake Victoria drainage Basin in Kenya

Basin	Area KM	Runoff Million M^3
Sio	1080	287
Nzoia	11900	1777
Yala	2650	1114
Kibes	490	68
Nyando	2650	247
Cheronget	560	23
Sondu	3220	845
Awach-Kabuon	610	180
Gicha-Migori	5840	952
Mora (including negligible contribution from Tanzania)	10830	1038
TOTAL	39840	6531

discharge contribution of 320 million M^3. This means that for Kenya's land catchment of about 45,000 Km^2 the gross discharge contributions is for the order of 7,000 million M^3 per year covering an area equal to 8.4 per cent of the total area of Kenya. The direct contribution over the entire Lake Victoria covering an area of about 70,000 Km^2 is of the order of 119,000 million M^3 and since Kenya covers about 5-20 per cent of the area, the gross direct precipitation input would be of the order of about 6-24 million M^3 per year.

Discharge hydrographs for the streams feeding the Lake Victoria drainage basin indicate that there is substantial intercatchment, seasonal, monthly and annual discharge variabilities in the surface water-resources of the Basin. Critical of these variabilities are the flood flow as well as the low flows whose regulation is important in the planning for the efficient development and utilization of the surface water resources in the basin.

Outflow from the entire lake in 1969 recorded at Owen Falls in Jinja was about 46,000 million M^3. Assuming that Kenya's contribution was of the order of about 5-20 per cent then Kenya's outflow into the Nile at Jinja would be of the order of 2,000 - 9,200 million M^3.

Evaporation which is responsible for most of the precipitation being lost to the atmosphere is high from open water surfaces and varies from 1250 mm per annum in high lying areas at altitudes of 3000 m to over 2500 mm per annum is areas below 300 m.

There has been considerable changes in land-use patterns within the Lake Victoria drainage basin in that areas that were formerly forested, have had to continue to give room for human settlement; rural and urban growth centres so that to date the entire basin has only 43,000 hectares of forest (Owino (1979).). Most of the area then is used mainly for cultivation and livestock rearing. These changes in land-use have given rise to geomorphic processes that favour greater surface runoff, (decreased sub-surface storage) which lead to accelarated soil erosion with associated high rates of siltation of river and other water bodies in the basin. These processes partly contribute to the flooding of river channels which is quite common in the area. Essentially then these processes greatly modify the hydrologic regime of the basin.

SURFACE WATER.

The determination of the gross total amount of water within the Lake Victoria Basin involves computation of the discharges contributed by the main perennial streams within the basin whose volume can be measured at appropriate River Gauging Stations, estimation of the contributions from the ungauged sub-catchments of the drainage basin as well as determination of the water which falls directly over the lake including groundwater seepage into the surface water bodies in the Lake Victoria drainage basin is shown in Fig. 2 and the discharge contribution by the individual sub-catchments is shown in Table 5 which is based on the 1969 data being 97 per cent input of normal year i.e. 1946-1970 data base. The River gauging network within the basin is shown in Table 6. The information contained in the data indicate that a part from the uneveness in the spatial distribution of the river gauging stations in the basin, these stations have been in operation for less than 50 years posing the problem of the short duration of hydrologic data that may not enable accurate and meaningful hydrologic predictions necessary in the basin. These stations are supposed to be read at least two times daily but in some cases lack of trained staff may lead to inaccurate hydrologic data being presented to the Ministry of Water Development headquarters.

The total gross discharge contributed by these gauged catchments within the basin is of the order of 6,531 million M^3 (see Table 5) representing a contribution of an area of 33,000 km^2 thus constituting 67 per cent of the total drainage system within Kenya. The ungauged land portion of Kenya's Lake Victoria drainage system is about 12,100 km^2 with an estimated

FLOOD FREQUENCY AND LOWFLOW

Grundy (1963) has analysed the 1961 - 1962 floods in Kenya and the data for the Lake Victoria drainage basin is shown in Table 7. It is not known whether this was a ten year flood or 100 - 300 year flood but UNESCO have shown that on the average a ten year flood of approximately 13,000 cusecs can be expected at Broderick Falls in Nzoia River while a flood of approximately 22,000 cusecs can be expected within the same period at Mumias.

Table 7: Data on 1961-1962 floods in the Lake Victoria drainage basin

BASIN	AREA (KM^2)	FLOOD FLOW(CUSECS)
Nzoia (1DA2)	8417	13000
Nzoia (1DD1)	10142	21000
Yala (1FG1)	2388	11000
Nyando (1GD2)	7375	29000
Sondu (1JF1)	3287	16000
Gucha (1KB1)	3100	30000
Mara (1LA1)	635	7000

The expected flood flows on the Kano Plains are shown in Table 8. The values given in that table are based upon probable 24 hour rainfall and characteristics of the catchment. It is essential to conserve this flood flow for effective use. This will minimize environmental degradation and untold human sufferings in the area resulting from the frequent floods. It is then necessary to initiate studies on the causes, and effective control measures of these floods as a matter of priority within the Lake Victoria Development Authority. The dry season flow of the entire basin is approximately 10 cumecs positively indicating that the Lake Victoria drainage basin is well endowed with surface water resources.

GROUNDWATER

The Nyanzian and Basement rock formation especially the basalts form aquifers in parts of the Lake Victoria drainage basin. Good aquifers are also found at the contact zones between the Tertiary and Basement rock formations. Sediments of the Nyando - Ahero plains forming semi and fully confined aquifers have yields which range from 2,00 - 5,400 gph. The Nyanzian volcanics yield about 2300 gph. Pre-Kavirondo (Nyanzian andesite,) tuffs, anglomerates and postintrusive granites in places yield 2070 gph.

Table 8: Expected flood flows on the Kano plains

Stream	Expected high flood flow (say one in ten yrs) (cusecs)	Probable maximum (once in 100 years) (cusecs)
Nyando at Ahero	20,000	35,000
Nyando at Ahero	27,000	48,000
Kibos at Railway	7,500	13,000
Bridge Chereungi/River at main Kisii Road	9,000	15,000

Groundwater stored with the Lake Victoria catchment covering an area of about 194,000 Km^2 is of the order of 70,000 million M^3. However, the total annual groundwater discharge is about 18 million M^3 of which 7.3 million M^3 is the discharge to streams and 4.9 million M^3 is the amount extracted by pumping. This may mean that Kenya's available groundwater is of the order of 16,000 million M^3. The annual groundwater discharge into Lake Victoria could be close 6 million M^3. These are broad estimates in view of the fact that no quantitative assessment of the groundwater in the Lake Victoria drainage Basin in Kenya has been attempted although the borehole yield data given above indicate that the groundwater potential in the area is quite high.

Groundwater within the Lake Victoria drainage basin falls within groundwater quality Zone 1. (Ongwenyi and Hove (1974)). The total dissolved solids concentration is of the order of 500 ppm but often below 1000 ppm. This is water of excellent chemical quality and can be put into a variety of uses. The only problem is that in places it contains excessive fluoride concentration far in excess of the 1.5 ppm stipulated for drinking water purposes. This is particularly a problem is water occurrying within the volcanic formations and this could be responsible for dental fluorosis found in parts of South Nyanza.

SEDIMENT TRANSPORT.

Although no systematic sediment transport study has been carried out in the entire basin, it has been shown by UNESCO (1971) that based on the pre-1965 data sediment being transported by the Nzoia river past Webuye and Mumias is of the order of 220,000 tonnes per year and 400,000 tonnes per year respectively. Examples of daily transport rates for major streams in the basin are shown in Table 9.

Table 9: Sediment transport in selected river basins in the Lake Victoria drainage system

RIVER	DISCHARGE (CUSECS)	SEDIMENT TRANSPORT TONNES/DAY
Nyando	2.56-35-8	35.8-2212
Mara	6.73-52.4	113 -4432
Gucha-Migori	7.5 -45.7	975 -1173
Sio	0.81-35.7	5.3- 468
Kibos	0.51- 3.88	3.7- 108
Nzoia	113.3 - 3	1018
Nzoia	126.1	837
Nzoia	98.3	1215
Nzoia	65.2	802
Nzoia	108	1646
Yala	78.81	282
Yala	97.76	628

The figures presented above very much underestimate sediment yields in the basin in view of the changes in land use that have taken place in the basin over the last 20 years. This in effect calls for urgent appraisal of the sediment production rates in the basin in view of the large number of reservoirs being planned for in the area for purposes of flood-control hydropower development, irrigation and other multipurpose uses. At present, there is not sufficient data which could be used to compute sediment yields or predict future sediment production by statistical means. The Nzoia River has got good records of rainfall, runoff and sediment transport but has not been thoroughly processed to enable quantitative assessment of the sediment production to be made.

FLUCTUATION IN THE LEVEL AND STORAGE OF LAKE VICTORIA

The high variability of Lake Victoria level attracted attention in 1962 when the Lake rose by 1.25 M. The level actually started rising in November 1961 and reached its peak in 1964. Such a peak had not been recorded since the beginning of this century. The Lake level was lowest during May 1922 to April 1923: Records of the Lake level indicate a variety of fluctuations. The Lake attains the highest level during May-June and lowest about December. The annual fluctuations in the Lake level and the discharge in the Victoria Nile are shown in Figure 3. One observation noticed on the figure is the general parallelism between the two curves.

Since the rainfall over the Lake as well as its watershed are the fundamental causes for the accumulation of water in the Lake, the variations in the component rainfall should be reflected in the Lake level fluctuations. While precipitation over and evaporation from the Lake affect the Lake level immediately, the precipitation on each watershed takes varying lenths of time to reach the Lake depending upon its mode of transport as runoff. It is necessary to state that there is no such a thing as a normal level of the Lake. The mean level for example for the period 1899 to 1960 is 11.07 M.

The monthly variation in storage of Lake Victoria is shown in Figure 4. The largest monthly gain of storage occurred in November 1961 (+560 mm) the highest loss is recorded in July 1924 (-225 mm). The annual extremes in terms of storage occurred in 1961 (+1081 mm) and 1918 (-640 mm). This is a reflection of the Lake regime in terms of contribution and extraction of water from the Lake and other hydrologic characteristics such as sedimentation. Questions have been raised regarding the factors behind the increased high level of the Lake that was attained from 1961-1964. The hydraulic Engineer within the Ministry of Works in 1964 with no scientific data hypothersized that the construction of the Owen dam and the attendant reductions in level of the Rippon Falls enabled a greater quantity of water to be discharged at Owen Falls such that the construction of the dam as a result of back water movement was not responsible for the rising of the Lake levels.

In 1964 the Water Development Department of Kenya approached the East African Meteorological Department with a request to study the meteorological background of the Lake level variations with a view of forecasting future behaviour. These cursory studies seem to have come to a conclusion that rainfall and evaporation regime was responsible for the rise in lake levels. The same Department attempted to evaluate the overall damage caused by these floods and concluded that "This is in the tune of several million sterling pounds".

While no scientific work has been carried out on this very important subject it is necessary to note that the rising in Lake level may not be explained in terms of one single factor alone. Studies carried out in the Upper Tana catchment (Ongwenyi (1978)) indicate that the 9250 km^2 catchment lost about 30 million tonnes of sediment during the 1961 floods. The same catchment had lost about 28 million tonnes during the 1968 floods. Under normal weather conditions the catchment looses close to 8 million tonnes of sediment annually. The Nzoia River past Mumias could be loosing close to 2 million tonnes of sediment annually. This may mean that under the flood conditions it could loose close to 7 million tonnes. This

means then that a considerable amount of silt gets into the Lake Victoria and depending on the trap efficiency of the Lake and the size of the particles being transported considerable sedimentation takes place within the Lake itself. It is not known as to how much accumulation of sediment has taken place ever since the Lake was formed as a major geomorphic feature.

This then calls for the assessment of the deposition that has taken place. This will be a major hydrographic survey that may require echo-sounding of the Lake bed because silting will have an effect in the level of the Lake realizing that land-use types have changed remarkably.

Another important factor to consider in relation to the level of the Lake is the geodetic tilting of the topography of the Lake. The observations above suggest that the variations of the Lake level which have significant effects on the surrounding areas cannot be explained by one factor alone because it is as a result of climatic, geomorphic, and hydrologic factors. The construction of the Owen Falls could as well be a factor. There is need therefore to mount sound investigations on the problems associated with the rise on the Lake levels which have not been unravelled so far.

POTENTIAL USES

The National Master Water Plan (1979) has evaluated the potential uses of the water resources of Kenya including the water of the Lake Victoria drainage basin. The uses are briefly reviewed below.

Nyando Catchment. The Nyando is the main stream bringing runoff to and through the Kano Plains. Its discharge ranges from 2 cumecs, enough for the Ahero Pilot Scheme of 800 hectares with design pump capacity of 1.275 to 700 cumecs . The river upstream from the plains may be considered in two parts:- The main tributary, the Ainomotua River, at about 850 km^2 of drainage area and the main river at about 1680 km^2 upstream from the Confluence Ainomotua.

Sir Alexander Gibb and Partners (1961) proposed the setting up of five reservoirs in the basin with a total gross storage of 100 million M^3 and not usable storage of 81 million M^3. They envisaged that these reservoirs would be sufficient to provide water for irrigation covering an area of 18,900 hectares. The relevant data pertaining to the five reservoirs is given in Table 10. The United States Bureau of Reclamation (1967) having examined the Gibb proposal retained only the Tinderet project in the scheme of development, but increased the useful storage zone to 19.7 million M^3. This continues to face a problem in that the

Tinderet proposal was based on estimates in that to-date there is no stream guaging station near this site. In absence of long-term data it is difficult to state if the other pre-1960 data used in proposing the reservoirs in question is representative enough. A part from this it is known that for the last twenty years land-use has changed rather dramatically in these regions favouring high sediment production within catchments such that it is necessary to compute possible sedimentation rates of the reservoirs to be constructed and their economic life be determined for there is a danger of these reservoirs not serving their purposes because of high silting rates. With this problem in mind the proposal should be based on sound hydrologic data such that it may even be necessary to re-evaluate the earlier reports dealing with this problem because studies elsewhere in the country have shown that rates of sedimentation have been greatly underestimated partly because of the unreliable analysis being employed. (Ongwenyi, 1976).

Table 10. The proposed Reservoirs on the Nyando River.

Storage site	Storage capacity Million M^3
Tinderet	14.9*
Twin Bridges	17.2
Londiani	6.2
Koru	23.1
Awasi	20.0
TOTAL	81.4

Note: *Includes Hydropwer Development.

The Gibb report and ILACO (1975) suggest that diversion of water from the Yala River with a power drop of 360 metres should be available for Kano irrigation. The Sondu River has also been proposed for irrigation. The same consultants call for a supplement of water from Lake Victoria but one fails to see the rationale behind these proposals bearing in mind the agreements existing with the riparian countries with regard to utilisation of the Lake Victoria waters. Furthermore, if the proposed reservoirs were to take into account conservation of soil and water in the basin the storage emanating from this reservoirs and the diversion of water from the other

two main streams i.e. Yala and Sondu should, to a large extent, be able to meet the irrigation requirements in the area and use of the Lake water should be a long-term plan.

Hydropower potentiality of the reservoirs in question should be fully investigated especially with respect to the Tinderet reservoir. It is necessary to point out here that the reservoirs to be developed should have a multipurpose outlook so that the basin can fully utilize the water resources available be it for flood control rural and urban water supplies, irrigation and hydropower purposes. In order to achieve these ends, detailed studies are required of the hydrologic and environmental situation of the area in question.

Sondu Catchment. The lower Sondu River offers an excellent potential for long-range development for hydropower generation and irrigation of the greater Kano plain covering a total gross area of 85,000 hectares. It is estimated that a 30 - cumecs flow can be regulated to provide hydropower generation. Another potential site is further upstream on the Kipsonoi River where regulation of the mean annual flow of the Sondu River could provide an irrigation supply of about 6-9 cumecs which would be diverted further up-stream into the Kano plains area.

Detailed studies are, required in order to rank priorities of reservoir development in this catchment in relation to the proposed five reservoirs in the Nyando catchment. Such consideration should be based on a multi-purpose use of the reservoirs to be developed taking into account the hydrologic data enabling such investigations and the consequent ecological problems that may arise from such development programmes. Obviously, such development require environmental monitoring before, during and after construction of such projects in order to avoid problems associated with the environment.

Nzoia Catchment. A multipurpose dam for Nzoia River has been proposed near the proximity of the potentially irrigable land near Rambula. At this site the river would be controlled to a steady discharge rate of 60 cumecs. This would provide substantial water supply for about 50,000 - 100,000 hectares irrigation within the variety of the reservior. The dam would also provide a hydropower supply with a capacity of 33 mw in addition to facilitating flood control and providing water for domestic and live-stock development in the area. The current and long-term sediment production in the catchment should be computed in order to justify the economic aspects for the development of this reservoir bearing in mind the economic life of this reservoir

Yala Catchment. The Yala Plan as envisaged by the United Nations Development Programme (1971) was to reclaim the Yala swamp for irrigation purposes in three phases:-

(1) The first phase was to cover a gross area of 3000 hectares
(2) The second phase to cover an area of 6000 hectares.
(3) The third phase to cover 7000 hectares.

These irrigation phases were meant for settlement of the people and thus ease the population pressure in the nearby Kano Plains, but according to ILACO (1975), the first phase would cover 2300 hectares, 2nd phase should cover, 9,200 and the 3rd phase was to cover 3500 hectares.

The Yala diversion canal with a drop weir and chute-type dissipation were completed in the beginning of 1970. The feeder canal, a flood-protection dyke from the river take off to the feeder canal and Lake Kanaboli. The first retention dyke were completed in late 1970. The Bunyala pilot project fed from the Nzoia River was put into operation in 1968.

The ILACO (1975) consultants only investigated one type of use of the water resources within only one area of the catchment. There is a possibility of developing a reservoir site on the Yala river in the Nandi Hills but this should be considered in relation to the use of Lakes Kanyaboli and Saru for storage reservoirs. This reservoir could be developed above station IFF2 with a multi-purpose useful storage zone of 100 million M^3. This storage zone lies between elevations of 1972 to 1910 metres. This useful storage zone would serve irrigation flood control and hydropower generation. With Lakes Kanyaboli and Saru, there would be a re-regulation of the discharge to provide for seasonal variations of irrigation demand and such amounts of storage would be far less than if no upstream storage were available.

Gucha Catchment. The water supply for irrigation as surface runoff would be provided by the Gucha River at its principal tributary the Migori River. Sufficient runoff to support a suitable multi-purpose project in the area may require one or more storage projects.

A dam of very limited capacity now exists on the Gucha River at Gogo Falls and has been used to provide hydropower mainly for the now exhausted mines at Macalder. The drainage area at this site (IKBIA) is 3022 km^2. The runoff of the 1964-1967 period is of the order of 24 cumecs. For a useful storage zone of 200 million M^3, the steady mean release rate would be about 20 cumecs but taking evaporation losses into account about 15 cumecs may be a more conservative estimate of the water availability at the site. The mean discharge at IKBIA is given as 40.9 cumecs by W.H.O. (1973) and 28.7 by

VIAK such - that the long term reliable records of runoff here are required. A mean discharge of 15 cumecs could provide for irrigation covering 19,000 hectares of rice as crop rotation No. 1 - 23,000 hectares with crop rotation No. 2 i.e. cotton, beans and maize and 21,000 hectares with crop rotation No. 3 i.e. sugar-cane.

These amounts would need to be reduced say by 20 per cent if the reservoir were to be used also for hydropower development. On the other hand, if the storage is used exclusively for power the output would be 3.7 MW but, however, with a multi-purpose project the output would be reduced to 2.7 MW. Flood control in this case may also be considered. A possibility of another reservoir being developed upstream above RGS IKC3 need to be examined.

Mara Catchment. A suitable dam and reservoir site for partial regulation of the Mara River exists on the Nyangores River. It appears possible to attain roughly 70 per cent regulation of the average annual flow of the river which would mean a release rate of about 7 cumecs.

The reservoir could provide water for possible irrigation of 12 - 14,000 hectares. This may provide a useful storage of 300 million M^3 such that this from the economic point of view may be developed as a multi-purpose dam for hydropower development with an out-put of 5MW.

RURAL AND URBAN WATER SUPPLIES.

Under the rural water supply programme close to 14 water projects serving a population of 150,000 using 15 million litres of water per day has been completed by 1973. Other 10 water projects were completed in 1978 serving close to 140,000 people while by June 1979 additional five projects had been completed. By 1984 another 19 projects would have been completed in line with the Ministry's Policy of providing every family with piped water by the year 2,000. In addition to the rural water supplies, there are close to 15 minor urban water supply programmes in the Lake Victoria drainage area aimed at providing water supplies at urban centres and for providing sewerage disposal. These programmes will have to be evaluated in view of the rapidly growing population in the urban and rural growth centres.

It is necessary to have a clear cut policy as to the retailing of water to the individual consumers who may not be able to afford individual water connections. It may be desirable to run "Water-kiosks" as opposed to communal watering points. This will enhence efficient management and conservation of the water available and will ensure that the consumer actually pays for the exact amount of water used.

In order to enable the consumers in the rural areas to make maximum use of the water an efficient system of maintaining the water systems will be necessary. The reading and checking of meters as well as distribution of water bills should be done regularly perhaps much more approximately on a monthly basis in order to enable the consumers to pay their bills before they accumulate to magnitudes that a consumer is unable to pay. Values of water conservation, maintanance and efficient utilization of this vital resource should be incorporated in the rural water supply projects so that the consumers readily accept measures of water conservations and utilization.

CONCLUSIONS AND RECOMMENDATIONS

The water resources of the Lake Victoria drainage area which have been assessed above lead to the following conclusions and recommendations:-

1. Although it has been shown that the rainfall and discharge monitoring network is good in relation to other drainage areas in the country, there is need to evaluate these rainfall and stream monitoring stations with a view of installing new stations to concentrate in appropriate areas of the catchment where vital hydrometeological data is needed. For example, this is particularly important in the upsteam portion of the Nyando River where the Tinderet project has been recommended for reservoir development. Such an evaluation would also facilitate adequate and reliable monitoring of the hydrological data in relation to the manpower available.

2. A systematic sediment monitoring programme should be initiated in the basin with a view of detecting the effect of this on river channels, sediment losses and siltation of the proposed reservoirs. This will enable appropriate water and soil conservation measures to be taken.

3. A programme of better land-use practices should continue to be strengthened as part of water and soil conservation programmes in the basin. In this regard formal and informal education on the values and measures of soil conservation should be part of agricultural and water development programmes in the basin.

4. There is a considerable potential of water resources in the basin. The water resources are still under-developed and underutilized. There is need for a comprehensive and well intergrated water development programme covering the whole basin.

5. A comprehensive programme of assessing flood causes and measures to alleviate flood damages with a view of controlling them should be given high priority in the Lake basin.

6. A research project aimed at detecting causes and possible damages of the rising lake levels should be initiated with a view of taking remedial action.

7. There is need to assess the appropriate soil and water conservation techniques including the construction of dams for hydropower development irrigation, flood-control, rural and urban water supplies. Such dams ought to have a multi-purpose framework. Construction of dams and other related water bodies should take into account other negative environmental hazards e.g. sedimentation health and pollution. This covers the proposed reservoirs.

8. Training of the necessary manpower at technical and professional level in all fields of water resource development, management, and utilization should be incorporated in the framework of the Lake Victoria Development Authority.

9. In order to disseminate hydrological and other scientific information "A Hydrological Yearbook of the Lake Victoria Development Authority" ought to be considered. This will facilitate adequate communication and interest the appropriate research in given areas.

10. All development programmes should be initiated against sound background research investigations.

REFERENCES

Hove A.R.T. and Ongwenyi G.S.O. (1973) An outline of Kenya's Ground Water Quality: Journal of Eastern Africa Research and Development No. 1 Vol. 4 1974.

ILACO (1974) irrigation Research Station: Ahero: Final Report No. 1 FAO

ILACO (1975) Ahero Irrigation Research Station: Final Report.

ILACO (1977) Ahero Irrigation Research Station: Research Results 1976 with supplement: Development possibility of Kano Plains in Western Kenya.

Ominde S.H. (1968) Land and Population movements on Kenya.

Ongwenyi G.S.O. (1973) The significance of the Geographic and Geologic factors in the variation of groundwater chemistry in Kenya. MSc. Thesis University of Nairobi.

Ongwenyi G.S.O. (1978) Pattern of sediment Production in the Upper Tana catchment in Eastern Kenya. Proceedings IAHS Bulletin.

Ongwenyi G.S.O. (1976) Problems of soil erosion and sedimentation in selected water catchment Areas in Kenya with special reference to the Tana River.

United Nations Water Conference E/CON. 70/TP 23 and Aqua Vol. 2 No. 21-2 page 85.

Owino F. (1979) Forestry and Wildlife in the Lake Victoria Basin. Seminar series on Lake Victoria Basin Development.

Sir Alexandar Gibband Partners (Africa) (1956) Kenya Nile Water Resources Survey.

Sir Alexandar Gibband Partners (Africa) (1961) An extension of the Kenya Nile Water Resources survey.

Republic of Kenya (1978) Preliminary Survey of River Basins Development Possibilities. Ministry of Water Development National Master Water Plan Stage 1.

U.N.D.P. and W.M.O. (1974) Hydrometeorological Survey of the catchments of Lakes Victoria, Kyoga and Albert.

U.S.B.R. (1967) Kano Plain Project Reconnaissance Examination: United States Bureau of Reclamation for U.S.A. AID

W.H.O. (1973) Surface Water Resources in Kenya.

THE QUALITY OF WATER IN THE LAKE VICTORIA BASIN AND ITS PROTECTION

By

Brian S. Meadows
Ministry of Water Development

SOURCES OF DATA

Water quality data for the Kenyan sector of the Lake Victoria basin is available from three main sources:

(1) Data collected by the UNDP/WMO Nile Basin Hydromet study (1)

(2) Monitoring programme of the Water Quality and Pollution Control Section in the Ministry of Water Development. Two short reports covering Nzoia and Nyando River have so far been prepared (2,3)

(3) Adhoc data collected in connection with specific water schemes.

Oxygen concentrations, taken to measure biodegradable pollutant levels were measured at 100 sites as part of a national survey by the WHO (4) and there is also data from a base-line study undertaken prior to the establishment of the pulp and paper mill on the Nzoia River (5). The available data upto 1976 on pesticide levels in water and fish has recently been collated (6). Heavy metal contamination of rivers in the Migori-Kihancha Region, which covers the Macalder gold belt, is available. (7) Primary production measurements have been undertaken in Lake Victoria by several workers (8,9,10)

The type of material available in the above enables one to assess the current suitability of water for drinking, irrigation and livestock watering as well as for specific industrial uses.

CRITERIA FOR DIFFERENT USES

In order to manage a river system it will be necessary to construct a classification system of watercourses in relation to their present or future uses although for the immediate future it is recognized that, save locally, pollution prevention will not be a task in rehabilitation, more an exercise in conservation of existing quality. In any classification system the following uses can be indentified:

(a) potable water supply
(b) irrigation

(c) fisheries
(d) livestock and watering
(e) industrial supply
(f) amenity and conservation

To assess the suitability of developing a water supply for a particular purpose quality criteria has to be established. For example, for drinking water purposes it is the policy to ensure that all piped supplies do not exceed the maximum desirable limits recommended by WHO (11) and this is a national standard. However, in the future it may be more realistic in view of the possible cost savings to set standards specific for Kenya. For example, the international standards rarely take into account the dietary habits of the population and the 10 mg/l level form nitrate is a case in point. This is based on a significant section of the population feeding their babies on an artificial diet rather than breast-fed.

The quality for irrigation waters will, however, vary according to the crops and especially the salinity tolerance; the sodium absorption ration which can be calculated from

$$SAR = \frac{Na^{+}}{\sqrt{(Ca^{2+} + Mg^{2+})/2}}$$

is a useful yardstick for a preliminary assessment of water use for irrigation. Irrigation waters with SAR values of 8 or less are probably safe. Values of 12 to 15 are marginal and continued use of waters much greater than 20 would certainly lead to serious sodium problems. However, it is essential for agriculturalists who will be employed by the Basin Authority to inform the water quality control scientists their specific requirements for each crop to be grown in any given soil zone so that they can plan as far as possible the quality of rivers. It would also be helpful if they could be told not only SAR values and the concentrations of specific elements (e.g. boron is a case in point) but also the actual percentage of time the water would have to be applied for a crop to be damaged.*

---

* The literature on water quality criteria is wide but two references in regular use and highly relevant to the climatic conditions in Kenyan than many European texts are as follows:
A compilation of Australian Water Quality Criteria. Australian Water Resources Council Technical Report No.7. Water Quality Criteria. California State Water Resources Control Board.

QUALITY IN RELATION TO POTENTIAL DEVELOPMENT

The most serious aspect from a health point of view is that currently virtually all the surface waters are contaminated with bacteria of faecal origin and it is well-known that in the Basin there is a very high degree of sickness (including regular outbreak of cholera) due to water borne and water-related diseases. This can only be solved by providing a safe treated water supply, improving excreta disposal, drainage and sanitation in a practical manner (22,23) reducing contact with natural waters as far as possible and education to improve personal hygiene. The medical aspects of the subject, however, are planned to be incorporated in another paper in this seminar series so that this paper deals primarily with chemical pollution.

There is a clear relationship between quality and geology for surface waters and this is briefly discussed elsewhere (2,3). Owing to the close contact between the water and the rocks, ground water is of course, very greatly influenced by the geology. Throughout the catchment the surface and ground waters so far investigated in any detail are generally of really excellent chemical quality. There appear to be fewer problems with excess levels of flouride, where laying down quality criteria has many contentious aspects, as compared to many parts of the Rift Valley catchment and the Upper Athi. Neither the nitrate levels nor the salinity are high as yet, however, due to the low re-charge rates ground waters is likely to be only a relatively small component of the water budget in the Basin area for exploitation.

While a few rivers contain iron levels slightly above the maximum desirable level and a large number exceed turbidity and colour units recommended by WHO, these waters do not contain levels of other substance that may require any special treatment over and above conventional treatment consisting of floculation, coagulation, filtration and disinfection.

In the 1972 dissolved oxygen survey (4) only in the Nyando River, Kasat River and Sosiani River were dissolved oxygen levels below 75% saturation but considering that these were the only rivers receiving any significant flows of industrial affluents at that time it was a clear indication that pollution was not being controlled wherever industry or large sewered populations were being established. The discovery of serious discharges of molasses to the Nyando River (12) in 1970 did lead to the establishment of a Water Quality and Pollution Control Section in late 1972 in the Water Department.

Using the SAR formula I have calculated values from surface waters in the Lake Basin and all values are less than five indicating good quality water for irrigation. In an irrigated field it is expected that about 40% of the water is returned to the river but with a much higher salt concentration so that with intensive agriculture it can be expected that the average salt concentrations in rivers will rise. High suspended solids can cause problems to distribution systems and damage pumps and mitigate against the use of systems such as dripfeed irrigation which is useful for alleviating salinization; unfortunately due to the poor enforcement of soil conservation measures in the Lake Basin virtually all the streams appear to be carrying excessive man-induced levels of suspended solids. This is not only wasteful economically since the loss of top soil will lead to a decline in land productivity but the silt can also act as a transport mechanism for leaching away and transporting fertilizers and pesticides since although they are not normally very highly soluble they can easily become absorbed on to clay parties. Elsewhere in Kenya, at Lake Baringo, the high turbidity caused by solids in suspension of the lake waters has been considered as a contributory factor in the decline of fish production. Sections of Lake Victoria could become similarly affected if soil conservation in the catchments is not enforced.

The water quality for livestock watering is generally less stringent than for human consumption so there should be no constraints save in the need for water of good chemical and bacteriological quality for top dairy cattle. Water quality for most industrial uses is excellent; silica levels in the Nzoia River could be lower for optimum boiler life and iron has to be removed prior to paper production at Webuye. Locally, such as immediately downstream of swamp where iron and manganese levels are likely to be highly variable this could be a constraint for some industries.

Nutrient levels are already elevated in Winam Gulf compared with the open lake outside (see Figure 3 in 10) and this could be due to nutrient enriched runoff accentuated by poor soil conservation and effluents from the Kisumu area which enter the gulf. Since nitrogen rather than phosphorous is the most likely limiting nutrient in Lake Victoria any increase in existing levels could be a major concern. At present, however, we do not know for certain whether the slight increase could in fact be beneficial. Nitrate in water comes largely from agricultural drainage (although distillery wastes and - two new factories at Kisumu and Muhoroni are being constructed - are high in nitrogen) so it may be necessary in the future to ensure a more efficient application of nitrogenous fertilizer because the more the nitrogen can be utilized by the crops the less there will be to pollute a water resource.

As yet, we also know very little about the effects of papyrus swamps on nutrient cycling in tropical lakes but it seems likely that they could have a major influence on water quality and production. Drainage of swamps should, perhaps, be one of the last development programmes to be tackled because they could supply through nitrogen fixation the major source of nitrogen, which depending on the circumstances could either be beneficial or undesirable. They could moderate nutrient inputs, and silt loads albeit increase the risk of flooding to lakes from runoff and maintain a low seasonal variability in primary productivity of the lakes, and swamps themselves could act as an efficient sink for any excess phosphorous through sedimentation with papyrus detritus flocs. Before alterations to swamp regimes are allowed to take place their importance must be evaluated because the development of lake fisheries, as one major example, could largely depend on their influence on primary production.

Pesticide residues and their breakdown products in water and aquatic organisms have been found in very low quantities and one reason for this, despite the relatively high usage, could be the rapid breakdown under tropical conditions as compared to temperate climates. For example, the half-life of DDT in an exposed plot at Nakuru was 120 days and 200 days in partially unexposed plot (14); this compares with a lifetime of 30 years recorded in forest soils in Canada. In the literature survey (6) a few relatively high figures were reported and this could suggest intermittent local contamination-perhaps occasional "spills" around irrigation schemes. Also the range of organo-chlorine levels found in the fish examined gives rise to some concern since the total body load could reach levels which are chronic. A recently published report on residue levels in Kenyan birds of prey (15) is however very disturbing since, although levels in water birds are low, birds feeding on land verterbrates in high-potential agricultural areas carried rather high residue levels.

Any recommendation to use more readily degradable pesticides should, however, always consider their potential acute toxicity especially to unsophisticated farmers and if they are recommended their use should be under very strict supervision. There is clearly a need for the development of more disease resistant plants. There is virtually no information available on the possible adverse effects of herbicides used for weed control in the Kenyan rural environment.

The Ecologist employed by any future planning authority in the Lake Basin should also be aware of the danger of transferring pathogens of undesirable species of fish between river systems; it is possible that the Nzoia River in its upper reaches could supply water to the Kerio Valley the only likely river transfer within the Basin itself is the possibility of diverting flow from the Sondu to the Nyando for hydro-power purposes.

Water Quality Model: A water quality model of the Upper Nile Lake system is currently under preparation as part of the U.N.D.P/W.M.O. Hydromet study and preliminary draft reports on mass-balances and tentative sub-models for algal growth, sediment/water interaction, fish, D.D.T. and copper have been issued. Aggregation of the submodels will not be complete until at least 1980.

LEGISLATION AND POLLUTION PREVENTION

The most comprehensive legislation for the control of water pollution in Kenya is the Water Act (16). All prospective water users must apply for a water permit before an abstraction or discharge and this is either granted or refused by an independent body outside of the Water Department with the powers of a tribunal - the Water Apportionment Board. Appeal can be made to the Minister. The Board consists of members from other ministries and the general public and the interests of commerce, industry and agriculture are represented while the Director of the Water Department in the Ministry of Water Development is the Technical Adviser. At the local level there are six catchment boards - two in the proposed Authority area i.e. Lake Victoria (North) and Lake Victoria (South) which review applications prior to consideration by W.A.B. Under the Act there is also established a Water Resources Authority to advise on water resources management but this Authority has not met for many years and in practice the Section Heads of the Water Resources Branch and the Resources Head in the Ministry could be said to carry out the functions intended under the legislation.

A suggestion to designate the incumbant Water Resources Authority a Water Protection Board on the same status as the Water Apportionment Board (or as a proposed Water Apportionment and Finance Board) is currently being investigated; this arrangement could have the advantage that pollution control could be seen to be completely independent of the water Department. The most relevant section is Section 182 and the rules made under this Section. Rule 72 states inter alia, "the effluent from any works in which water is used in

any process shall be returned to the body of water from which it is diverted or abstracted or to such other body of water as may be authorized by the Board in such a degree of purity as will satisfy the Board."

Rule 72 clearly gives this Board the power to lay down standards of effluent quality while another very useful rule is Rule 75 which allows standstill orders on a development project where clearly an intention to wilfully discharge a polluting effluent is highly likely. This rule has been used to back up two cases where otherwise factories would have gone ahead and discharged noxious effluent to watercourses. The rule should also be used when it is clear that development in a municipality is outstripping the sewage treatment capacities. Rule 75 states inter alia "The Water Apportionment Board shall have authority to determine (my emphasis) whether or not any sewage, effluent from any works or any other material or substance of any kind being put, or proposed to be put, into any body of water or watercourse is prejudicing or will prejudice the beneficial use for any purpose of the water of such body of water or watercourse and further may order the removal of any such matter from or from any site adjacent (my emphasis) to any body of water or watercourse and any person who refuses to obey such an order shall be guilty of an offence." One problem which still remains, however, is that frequently on increase in the production capacity of an existing installation is not discovered until some time after the extensions.

Rule 74 lays down minimum treatment standards for coffee effluents which are the most widespread and potentially serious pollutants in Kenya and this Rule has been subsequently updated by Gazette 627 (Kenya Gazette of 9 March 1976). Unless the Water Apportionment Board otherwise permits, all projects liable to cause pollution shall be prepared by a qualified engineer (Rule 38) and Rule 48 states "Whenever water is used, or proposed to be used, in any works or in any process whatsoever which, in the opinion of the Water Apportionment Board, may cause pollution there shall be submitted when so required by the Water Apportionment Board a plan showing:

(a) the proposed or existing works for the disposal or purification of the effluent;

(b) a detailed description or specification of the works, methods or processes used or to be used in the purification of the effluent.

There appears to be, however, one drawback to this rule and that is that it is not really clear if the Board has power to investigate the actual factory

processes. At the time of drafting it appears that it was considered that the process technology was private property and to be treated as a trade secret and the Board should only be concerned with setting standards and then assessing the likely efficiency of the proposed treatment plant. In contemporary pollution control work with greater demands being placed on the apportionment of flows and stream assimilation capacities it is essential that the maximum water conservation and recycling of chemical is employed as far as possible. Without knowledge of factory processes being employed how, for example, is a Pollution Control Officer now able with any degree of accuracy to assess if a company is applying for double its requirements in order to simply dilute its effluent to meet the WAB requirements, as I am sure has happened in the past. The Water Quality and Pollution Control Section do now, in fact, request a number of questions to be answered about work force, hours of operation, shut-down periods, storage of oil tanks and dangerous chemicals, surface water drainage, usage of chemicals and production capacities, etc., in addition, to details of proposed treatment. However, even with the above legislation there is a danger that a factory can by-pass the WAB completely and this occurs when a polluting industry is set-up within a municipality. Firstly, these can miss the Ministry of Water Development since under the Planning Act- even for those developments within townships-the Ministry of Lands and Settlement appears to be only under a statutory obligation to send a water questionnaire to the Water Department when a change of designation, say from agricultural to industrial is required. Physical plans seem to have no legal backing. The current Development Plan, however, states that such plans will, in future, have to be followed. In the past the Ministries of Finance and Planning and Commerce and Industry have signed on behalf of the Kenya Government not only to allocate an industrial plot but also to supply water and sewarage without any consultation with the Water Department regarding the availability of supply and disposal. Rivatex Ltd. at Eldoret is a case in point. There is obviously a need for some form of licensing system to be established which will consider environmental aspects for approval in principle even before any proposed development is submitted to the New Projects Committee under the auspices of Ministry of Commerce and Industry.

Before approving the setting of a factory in any particular town it is necessary to look at the environmental impact of a development in its entirety. The Government is therefore, taking steps to introduce an

Environment Assessment Bill that when enacted will ensure that all developers must produce a planning document in the form of an Environmental Impact Statement. This should go a long way in saving a situation where the Chairman of a relevant statutory board first reads about a new factory connected to his field of interest from the daily press! There should also be attempts to encourage a clearer policy with the top decision-makers due to increased awareness of the problems, and in the eventual planning decisions; it may be necessary to specifically exclude certain industries, say a large water consuming one, from certain areas. The value of the Impact Statement is to make a developer think about the environmental consequence of his project. The clearance procedure must clearly not be too slow since holding-up development could have serious consequences. Initially the statement could be in a form of a checklist with various impacts graded as suggested previously (see 21 for details). It is unlikely that the Government will have the manpower resources in the immediate future to enable the quick evaluation of very detailed technical proposals. A publication of intent may be acceptable but public enquiries could become political reason at the current stage of development in the country and do more harm to the environmental cause than good.

There is reasonable legislation to enable local authorities to control the quality of effluents discharged to their sewers under the Public Health Act. There are also provisions for charging which when done is on a flat-rate basis vis a-vis the water consumption and does not give any incentive for balancing, water conservation or pre-treatment. A formula giving the possibility of a company to opt to do a substantial amount of its own treatment should be encouraged. In most cases the Mogdon formula should be used; there is no justification for using the WHO recommendations (4) where ponds are used since experience now shows that the expense of maintaining anaerobic lagoons merits limiting the suspended solids content of the influent sewage. One Municipality has adopted a strict attitude of only accepting domestic sewage and all significant industrial effluents have to apply to WAB to discharge after treatment to a watercourse. The current policy for the two main industrial towns in Lake Victoria catchment, namely Eldoret and Kisumu, appears to be the reverse. There are two arguments; on the one hand certain effluents are far easier to treat in admixture with domestic sewage. Tannery effluent is very expensive to treat on-site (as much as 100% of the capital investment to reach a standard of 20 BOD and 30 SS).

On the other hand the primary objective of sewage treatment in the tropics is pathogen removal - rather than BOD, as was originally the case of developed countries- because everywhere the downstream water is normally being used directly for consumption. In addition toxic effects of industrial effluents which inhibit algae production or their accumulation in fish tissues could mitigate against the use of maturation ponds as pontential for fish culture (22).

Eventually codes of practice should be produced, as for coffee effluents, for major industries. In the basin, sugar factories and tanneries are two likely industries where such codes could be useful. In the latter case these should, of course, with appropriate modifications, also be applicable to discharge to sewers or streams.

How can WAB exercise closer control directly over sewage works operated by local authorities? Rules 72 and 75 of Section 182 of the Water Act certainly give some power which has been used and never contested but there is, as yet, no case law. Since local authorities and the Ministry of Local Government are reluctant to hand over control and it is the current policy anyway to decentralize services I suggest that it must be made mandatory and enforced that local authorities provide WAB with monthly returns as from some future date; these should be available for public scrutiny and the powers to enable WAB to collect the information could easily be incorporated into Rule 75 of Section 178. They could be provide the basis for standstill orders on development when it is deemed necessary. It is generally well known that local authorities are less interested in waste disposal than supply.

Eldoret will shortly have eight major industries and should have a chemist or at least a fully qualified laboratory technologist experienced in trade-effluent and sewage treatment on its staff. Kisumu Commission has recently established such a post.

At present the Water Quality and Pollution Control Section gives advice to the Ministry of Local Government and the Development Branch controls project design of all new works. My Section is currently preparing a manual on how to inspect trade premises and sample effluents but the question is how extensive should any of our extension services to local authorities be. The Director of the Water Department is the Chief Adviser to the Water Apportionment Board and he can be placed in a very awkward position in being both advisor to local authorities and policing them at the same time! Nevertheless

the Water Act should definately be ammended to give the Water Apportionment Board power also to give permits for waste- water discharges for all industries irrespective of the source of water- supply and method of effluent discharge.

One problem which may arise in South Nyanza is the problem of an abandoned mine; heavy metals will continue to leach out and if the mining company has already gone into liquidation how can pollution prevention be enforced. The Water Act is not of any assistance in these circumstances. The existing Water Act also gives WAB very limited power to deal with air pollution where there is an obvious risk of water pollution. This is very loosely implied by the wording of Rule 75.

Soil conservation needs to be tackled urgently. A useful review of the Kenyan situation has recently been published (20) and as so clearly shown in the Migori-Kihancha (7) and Nyando River (2) studies the rivers draining to Lake Victoria are already being heavily contaminated by excessive silt and coloured materials washed out from the soil in periods of high rainfall. In the Nyando catchment based on colour units at periods of low conductivity (i.e. in periods of rainfall) it was possible to tentatively suggest that soil erosion was less severe in the northern area, which is drained by Ainomotua River than in the southern part. It should be possible to detect those sub-catchments needing immediate rehabilitation through regular stream sampling. The Water Act under Section 14 also provides legislation to control soil erosion in a catchment area.

Where the Minister, after consultation with, or on the advice of the Water Resources Authority, is satisfied that special measures are necessary from the protection of the water resources in or derived from any area, he may declare such area, or any part thereof, to be a protected catchment area, and may, by order, require, regulate or prohibit the doing by any person in such protected catchment area of any act which he considers necessary for the protection of such area or from the protection of the water supply obtained therefrom; and any person so ordered who fails to comply with the provisions of such order shall be guilty of an offence and liable to a fine not exceeding ten thousand shillings.

PROCEDURES FOR THE ASSESSMENT OF ASSIMILATION CAPACITY

Prior to 1972 the only standard adopted for river discharges were the Royal Commission recommendations of a suspended solids concentration of 30mg/l and a Biological Oxygen Demand of 20mg/l (5 day at 20 degree C).

The use of the 30:20 condition which has the advantage of simplicity can be applied with a minimum scientific appraisal. However, by adopting it universally it will fail to take into account the different uses of the watercourse downstream of the discharge. There are of course very grave shortcomings in defining only two parameters in an era of expanding chemical industries and, especially in the tropics, for not including any bacteriological criteria.

The current approach is then to look at the self-assimilation capacity in relation to the appropriate flow and quality conditions. This is a difficult task and the approach for rivers has been described elsewhere (17, 18, 21) and will not be expanded upon further in this paper other than to reiterate that the principal objective of a mathematical model for water quality planning purposes is to optimize the quality of effluents which are discharged to the river system and to ensure that the desired river water quality is maintained at minimum cost. The latter could be achieved by either river regulation or tertiary treatment depending on cost-effectiveness. Planning for future treatment at Eldoret Sewage Works is a local example (19).

Spare capacity is a tricky problem; we do not want a new factory to take up all the self-purification capacity. This could clearly lead to practical difficulties later when a new industry may wish to locate itself on the same river especially since, in practice, it is also much more difficult (although possible under Section 98 of the Water Act) to get an existing factory to upgrade its treatment facilities than one which is still awaiting clearance for construction. It is, therefore, essential that spare capacity is retained in the river, equivalent to the anticipated increase over the next half-decade, or any longer period judged to be appropriate. Only sound population forcasting and industrial planning by the Basin Authority will allow the Water Apportionment Board to adopt and maintain the fair approach. The other alternative will be to insist on stringent standards from the start and it should be noted that tertiary treatment could add 25% to the capital cost of waste-water treatment - at this end of the treatment stage the law of diminishing returns applies.

WATER QUALITY CONTROL: MANPOWER RESOURCES

The Ministry has established a well-equiped laboratory in Nairobi where effluents can be tested and there are also facilities for carrying out bio assays on effluents to assess their toxicity. There are only seven

officials (at the time of writing, June 1979) working full-time on pollution control enforcement and these are dealing not only with the vetting of new factories and sewage works at the planning stage but also with the day-today inspectorate work (there are two Kenyan graduates and three qualified Kenya technicians and two expatriates now working in a mainly advisory role). In the Lake Victoria basin there is one full-time graduate dealing solely with pollution problems in the catchment. The laboratory has a support staff of two graduate chemists, a biologist and 12 technicians (8 qualified - 4 to Advanced City and Guides). Currently one graduate is working on the treatment of effluents arising from the processing of coffee, and two others are working full-time on the IDRC Global Waste-Water Reclamation Project. (22) The remaining graduate is operating the audit water supply programme at water treatment plants where the WD is the water undertaker. Initially when the Section started it had a small number of officers it was sensible to combine all the knowledge at one centre and in any case one had to be a jack of all trade(s) in a small organization. Now, however, the new graduates will now have more specific job allocations and there will be a need to recruit more specialist officers and open regional offices.

The Department of Civil Engineering has an M.Sc. course on Environmental Engineering which is also open to chemists and biologists with experience in the water industry, and the Department of Chemistry runs a MSc. course in Environmental Analytical Chemistry while the Department of Botany and Zoology have a limited number of postgraduate research openings in aquatic pollution biology and fundamental limonology. The law faculty teaches environmental law. In the teaching profession there is an increasing emphasis on environmental aspects, including water pollution control, during teacher training.

The Basic Authority must clearly have a Hydrologist and an Ecologist on its permanent staff to look at the strategic planning in connection with water resources management (water storage, river transfers, apportionment). These officers will require base-line data from a quantity and quality river network and it will be in the Authority's interest to ensure that the Resources Branch in the Water Department is kept at full strength as it will be running the monitoring of flows and quality and doing the research necessary for appropriate treatment and design criteria for stream quality criteria. Much of the data collected under the Ministry's network programme is not, as yet, comprehensive enough to detect trends less than 100% over 10 years with 95% confidence of a parameter which has a coefficient of variation in the range of 40%.

Likewise the WAB needs to be strengthened and its Secretariat should be seen to be more independent of the other sections in the Ministry, even perhaps, initially, by simply having very distinctive letter heading!) Its bailiffing must be highly efficient in its apportionment enforcement and assisted by the backing of swinging penalties for default; possibly a tariff structure could be devised to contribute to the independent financing of the bailiffing and pollution control inspectorate as under the Water Act it was not the original intention for people who are designated as Water Bailiffs such as the present technical staff in the Apportionment Secretariat to be civil servants and paid from the consolidated fund. The licence fee, which when paid is the only expense incurred, gives little incentive to potential polluters to control the volume or quality of effluent being discharged.

A tariff system, if introduced, in order to collect revenue from dischargers could be the incentive necessary to ensure that industrialists are always co-operative and at the same time it is only correct that they should contribute to the up-keep of the inspectorate, monitoring, research and secretariat.

REFERENCES

1. Annual reports of the Hydrometeorological Survey of Lake Victoria, Kyoga and Mobutu Sese Seko, a joint project of the governments of Burundi; Egypt, Kenya, Rwanda, Tanzania, Sudan, Uganda and UNDP/WMO.

2. Ministry of Water Development (1976). The Water Chemistry of the Nyando River 1974-5. Technical Report No.1, Water Quality and Pollution Control Section, Resources Branch. MSS deposited in library of Ministry of Water Development.

3. Ministry of Water Development (1976). The Water Chemistry of the Nzoia River 1973-5. Technical Report No.4, Water Quality and Pollution Control Section, Resources Branch. MSS deposited in library of Ministry of Water Development.

4. World Health Organization (1972). Sectorial Study and National Programming for Community and Rural Water Supply, Sewerage and Water Pollution Control in Kenya. Brazzaville.

5. Walter, H., Dunne, T., Kokwaro, J.O., and Peter, T. (1971) Ecological Survey of the Middle and Lower Nzoia River in Kenya. Report of a UNESCO Survey for the Government of the Republic of Kenya, Nairobi.

6. Kallqvist, T., and Meadows, B.S. (1977). Pesticide levels in the Kenyan rural environment. African Environment, Vol. II, and III, 1,163-170.

7. Viska EA Ltd., (1975). Migori-Kihancha Regional Master Plan. A Water and Land utilization Report prepared for the Ministry of Water Development. 5 volumes.

8. Talling, J.F., (1965). The photosynthetic activity of phytoplankton in East African lakes. Int. Revue ges Hydrobiol., 50, 1-32.

9. Melack, J.M. (1965). Limnology and dynamics of phytoplankton in equatoria African lakes. Ph.D. thesis, Department of Zoology, Duke University, USA.

10. Ministry of Water Development (1978). Limnological Investigation of Lakes in Kenya 1976-1977. Technical Report No.6, Water Quality and Pollution Control Section, Resources Branch. MSS deposited in library of Ministry of Water Development.

11. World Health Organization (1971). International Standards for Drinking Water. 3rd Edition. Geneva.

12. Ngunya, E.A. (1975). Some administrative aspects of establishing a pollution control organization in a developing country. Progress in Water Technology Vol.7, No.2. 83-91.

13. Beauchamp, R.S.A. (1953) Sulphates in African inland waters. Nature, 171, 769-771.

14. Wandiga, S.O. (1979). Analysis of chemical pollution in some Kenyan water systems with special reference to Lake Nakuru. In the role of water resources in development ed J.B. Castelino and C.P.M. Khamala Advancement of Arts and Sciences.

15. Frank, L.G. (1979). Toxic chemicals and African birds of prey. Swara Vol.2, 1, 10-13.

16. Government of Kenya (1962). Laws of Kenya - a revised edition, Nairobi.

17. Edwards, R.W. and Owens, M. (1965). The Oxygen balance of streams. In Ecology and the Industrial Society (eds. Goodman, TG. T., Edwards R.W. and Lambert, J.M.) Oxford.

18. Meadows, B.S. (1973). Effluent standards in Kenya. In Proceedings of a Seminar on Sewage Treatment (eds. Mara D.D. and Fraser J.I.). Department of Civil Engineering, University of Nairobi.

19. Patel, I.B., Mangat and Partners (1979). Eldoret Water Resources Investigation. Nairobi.

20. Edwards, K.A. (1979). Water Resources and Soil Conservation: the Kenyan Situation. In The role of water resources in development ed. J.B. Castelino and C.P.M. Khamala. 167-176. Nairobi. Kenya Naitonla Academy for Advancement of Arts and Sciences.

21. Baker, D. & Meadows, B.S. (1978). Water Development and Resources Management, UNDP/UNEP/GOK Working Document, Environment & Development Seminar, Nyeri. August, 1978.

22. Shirkie, R. (1977). Ponds reduce Wastes. The IDRC Reports, Vol. 1.6, 4, 7-8.

23. World Bank (1978). Appropriate Sanitation Alternatives: A Field Manual. (Energy, Water & Telecommunication Dept.)

24. International Development Research Centre (1978) Low-Cost Technology Options for Sanitation: A State of the Art Review and Annotated Bibliography Ottawa.

INTERNATIONAL LAW AND THE LAKE VICTORIA AND RIVER NILE BASINS*

By

C. Odidi Okidi
Institute for Development Studies
University of Nairobi.

INTRODUCTION

The Nile River and Lake Victoria together constitute one of the world's largest fresh water basins. This view takes into account the fact that Lake Victoria is the second largest freshwater lake in the world, after Lake Superior, and it also has the longest shoreline of all Lakes in the world. The Nile, on the other hand, is the second longest river in the world, after Mississippi. If one considers that the Nile was central to the development of Egyptian civilization, then one has to conclude that the Nile as a river has had one of the oldest and most critical set of uses in all history. Beside Egypt, there are eight other coriparians of the Victoria and Nile. They are: Sudan, Ethiopia, Zaire, Uganda, Kenya, Tanzania, Rwanda and Burundi. One estimate suggests that the whole catchment area totals 2,900,000 square kilometers, which represents one-tenth of the area of Africa.[1]

Therefore, the Nile and Victoria system are some of the basins which should have engaged the most widespread and detailed scholarly and policy studies as instances of shared natural resources whose legal regime is now subject to serious debates inside and outside the United Nations system.[2] No doubt, for the basin states such studies should have been enhanced and encouraged by the fact that water, like land, is a high priority subject in any development planning. As such, the African countries to which development planning is a priority concept should have had extensive studies on how

---

1. Camponera, D.A. "The Nile River Basin Legal and Technical Aspects" mimeo paper of August 1958 being an English translation of an Italian version, "II Bachino Internazionale Del Nilo Consideration Giuridishe" in La Comunita Internazionale Vol. XIV Jan 1959 pp. 45-66.

2. See a general compilation of this developments since the turn of this century in Camponera, D.A. The Law of International Water Resources Background Paper No. 1 Rev. i Legislation Branch, Food and Agricultural Organization of the United Nations, Rome (1978); UN. International Law Commission, Legal Problems Relating to the Non-Navigational Uses of International Water Courses (Report to the Secretary General of U.N.) U.N. Doc. A/CN.4/274 Vols. 1 II March 25, 1974 being a report of the 26th Session of ILC. and the Report of the Intergovernmental Working Group of Experts on Natural Resources Shared by Two or More States UNEP/GC. 7/7 of 14 June 1979 p. 139.

* A totally revised and up-dated version of this paper is published as "Legal and Policy Regime of Lake Victoria and Nile Basins" Indian Journal of International Law Vol. 20 No.3 Sept, 1980 pp. 395-447.

the fresh waters of Lake Victoria and the Nile could be used by each of the riparian and basin states without necessarily injuring the interests of any other, or jeopardizing the opportunity of using the water within any of the basin states.

The superlatives on the factors regarding the Nile and Victoria system and the possible uses to which the waters are put could be paraded further. Yet what is true is that since 1960, the eve of independence of the majority of the riparian states, there has been no agreement concluded on the uses of the Nile. The year 1959 and 1960 saw one agreement and protocol respectively, between Egypt and Sudan for their utilization of the Nile waters.[3] Before the 1959 Agreement these were about eleven agreements focusing on the White Nile and the Egyptian interest as we shall see later.[4] Understandably, the concentration on Egyptian interests was a part of the historical factors mentioned above and the fact that the White Nile had a source in a reliable water storage - The Lake Victoria. Let us observe here, first, that since 1960 all the states sharing the Nile and Victoria basins have received their political independence. Therefore, if the treaties referred to above purported to apply to their territories, the provisions might require a fresh look. This suggestion assumes that political independence and complete change in the governance and society might so change the circumstances that the application of the treaty provisions might be called to question.

Secondly, since 1960 the range of uses to which the water is being put in the basin states may have increased or that there may be so many more plans in store for the waters that the safeguards in the pre-1960 treaties may be either inadequate, irrelevant, or contrary to the present exigencies of development in the basin states.

Thirdly, beyond the review of the existing treaties there may be a necessity for an established forum of machinery for policy review and consultation to keep pace with the dynamic nature of changing circumstance of political economy and development planning. This is the sphere of institutional framework and policy recommendations for continuing use of the basins with the significance pointed out earlier.

---

3. That was within two years after Sudan became independent. The agreement on the Full Utilization of the Nile Waters was signed by Sudan and Egypt at Cairo on 8 Nov. 1959. It was the Protocol Concerning the Establishment of the Permanent Joint Technical Committee for the implementation of that Agreement which was signed by the two states at Cairo on 17 Jan. 1960. See text in United Nations Legislative Series, Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Othe Purposes than Navigation. ST/LEG/SER.B/12 (1963) pp. 143-149.

4. See Section IV below.

The directive by Kenya's President that Kenya will establish a Lake Victoria Basin Authority, for Kenya's part of the lake, to spearhead development within the basin area falls into the above picture for a number of reasons. First, it will increase the range of uses of the Lake water, which is a resource shared by three states, and Kenya has only one-tenth of the total area. Secondly, it may raise the question whether Kenya is under any obligation to consult with other riparian states before it embarks on any major projects using the lake water, especially for irrigation. Thirdly, it raises questions as to whether hydrologically, Kenya will have sufficient quantities of water at the necessary vertical level to meet its needs. If not, will Kenya need to request cooperation of the other riparians states, especially Uganda which controls the outlet to the lake at the Owen Falls at Jinja, to maintain a proper lake level to facilitate Kenya's goals. Fourthly, it raises questions about Kenya's interests in the conservation and harvesting of fishery resources. Kenya may want to embark on a major development strategy where the lake fisheries are crucial. For that purpose there might be a necessity for cooperation among the riparian states to ensure that harvesting of the fisheries takes into account maximum and economically sustainable yield. In this connection, the underlying premise is that even though Winam Gulf is distinguished from the rest of the lake at the Uyoma point, fish will not respect the territorial boundaries over the lake. Of the total area, Kenya has only 10% while Tanzania has 50% and Uganda 40%.

The plan to establish the above development Authority ought to start Kenyan policy-makers thinking about the implications of the above four questions in view of the three observations made in the preceding paragraphs. It should be pointed out here, for the sake of completeness, that even if the proposed Authority was not to materialize immediately the need to reappraise the legal and policy regime of these basins still remains.

This paper is intended to raise questions and to provide a frame-work for consideration of some of the questions. The main focus is to analyse the range of treaties that have ever been concluded on the consumptive uses of the waters of Lake Victoria and Nile system. But that analysis will be preceded by an expose of the international legal principles governing internationally shared water resources. The adequacy of the existing treaties to cope with the full range of possible and actual uses of the Nile and Victoria waters may then be viewed with the background to applicable law in mind. Some recent developments in terms of actual or intended projects in the

basin states will clearly suggest that there is urgent need for an upto date framework for dealing with the Nile and Lake Victoria waters.

II. GEOGRAPHICAL AND TECHNICAL PERSPECTIVES

Lake Victoria sits on the eastern African plateau at an elevation of 900 meters and surrounded by a relatively low-lying land averaging 1100 meters around its shores.[5] The total area of the Lake is approximately 68,800 square kilometers of which the Kenyan share is about 10%. This share tapers in to form the Winam or Kavirondo Gulf almost separated from the main body of the Lake by a construction at the Uyoma point - on the northern sides overlooking Homa Hill on the Sourthern shores. Kisumu, the most important urban and commercial centre in Kenya west of the Rift Valley, stands at the end of an elongated bay on the northeastern end of the Gulf.

The surface water contributed into the entire lake by rivers is entirely from the Kenyan and Tanzanian on the eastern and southern sides, respectively. The most significant, in terms of size and often-mentioned rivers are Kuja, Awach (Kibuon), Miriu (Sondu), Nyando, Yala, Nzoia and Sio in Kenya; and Mara (which crosses into Kenya), and Kagera in Tanzania. Of these rivers, Kagera has had some historical significance among those who believe that it is the southern most of the Nile. But that aside, the Kagera River is significant in that it drains also the territories of Rwanda and Burundi, a fact that has made it a subject of a special international basin commission comprising the three governments.[6]

The only important river linked to the Lake in Uganda is the Nile which is the only drainage outlet from the Lake Victoria. It is at this outlet that the Ugandan industrial town of Jinja is located. The exit discharge passes through the Owen Falls Dam which was commissioned in 1954[7] to provide hydroelectric power for Uganda with some export to Kenya.

---

5. Ongwenyi, G.S. "Water Resources of the Lake Victoria Basin of Kenya" Seminar Series on Lake Victoria Basin Development, N. 5 IDS, University of Nairobi, May 1979 p.1.

6. The treaty between Tanzanian, Burundi and Rwanda which was signed in 1977 will be discussed later. See report in The Standard (Nairobi) Nov. 1977 p.4 and The Standard (Nairobi) 17 Oct. 1978 p.8.

7. The agreement for the construction of Owen Falls Dam was reached, through exchange of notes between Britain, the colonial administrators of Uganda, and Egypt. The construction started in May 1949 when the agreement was reached. See Section IV below for detailed discussions.

Accordingly, one group of experts maintains that "after the construction and Commission of the dam, the release through the dam constitute the most reliable estimates of the exist discharge from Lake Victoria. The releases from the dam are in two parts, namely, (i) releases through the turbines and (ii) releases through the sluices. These discharge power generation and the balance of flow released through the sluices the total discharge downstream conforming to the "natural regime" of the river at Jinja".[8] This is the way the system is supposed to work and the "natural regime" here means the same rate at which water flowed out of Lake Victoria before the Dam was constructed. We shall come back to this issue in Section V below.

The stretch of the Nile from Jinja to Lake Kyoga is called the Victoria Nile. Between Lake Kyoga and Lake Albert now called Mobutu Sese Seko, is called the Kyoga Nile. The river leaves "Kyoga as a sluggish broad stream until it is interrupted by rapids at Kamdini, after which if flows over a series of small rapids /then/ to the Murchison Falls which is the largest waterfall in the White Nile system".[9] Then the river reverts to the broad and sluggish flow until it enters Lake Mobutu Sese Seko in a swampy delta. It exists from this lake on the northern toe, flowing northwards in what has been referred to as the Albert Nile, which is the only outlet to that lake. It is at Lake Albert (Mobutu) that Zaire, as a basin state of the Nile becomes prominent because River Semiliki flowing from that territory, enters the lake at its Southern toe.

---

8. Report of the Hydrometeorological Survey of the Catchments of Lake Victoria, Kyoga and Albert (Burundi, Egypt, Kenya, Rwanda, Sudan, United Republic of Tanzania and Uganda). Vol. 1 Meteorology and Hydrology of the Basin Part II (Geneva: United Nations Development Programme and World Meteorological Organization. 1974 RAF. 66-025 Technical Report No. 1) p. 578.

Agreement to constitute the Survey was signed in on May 31, 1967 between the above-mentioned states and the UNDP and WMO, the latter being the executing agency. See this background in United Nations, Management of International Water Resources: Institutional and Legal Aspects ST/ESA 5 (New York, 1975) p. 142. Meteorology.

The headquarters of the Hydromet Unit is at Entebbe but because of the recent political situation in Uganda the Unit is temporarily based in Kenya. It is headed by Mr. Pag El Sir Ahmed of Sudan as the Director, Mr. Abdul Hoda of Egypt as the Deputy Director and Dr. George Kite of Canada as Chief Technical Advisor designated by WMO.

9. Meteorology and Hydrology of the Basin, Supra, p. 620. It might be of interest why Ugandan authorities chose to construct Owen Falls Dam rather than harness Murchison Falls for hydroelectric power. Murchison Falls is reported to have a drop of 400 meters which some water engineers believe is of considerable potential.

Between this point and Malakal in Sudan the river is known as Bar el Jebel part of the White Nile. The slope down the stream is gentle making for a broad sluggish and Swampy river. This is the area of the well known Sudds of Southern Sudan where alot of water is said to be lost in evaporation and soakage. Several tributaries of the Nile also join the mainstream around this area, including the Sobat from the Ethiopian highlands, and this reinforces the Sudd. According to Albert Garretson, of the twenty-four milliards of water that flow downstream from Lake Albert (Mobutu Sese Seko) and the East African highlands, twelve million are lost by evaporation and soakage in the Sudd area of Southern Sudan.[10] The suggestion is that this area is a massive swamp the main concentration of which is between Jonglei in the south and Malakal in the north. It is the "loss" of water by evaporation and soakage that has justified construction of the Jonglei Canal considered in the fifth section of this paper.

Beyond Malakal the White Nile flows directly northwards upto Khartoum where it is joined by the Blue Nile. The latter drains the Lake Tsana which sits on the Ethiopian highlands. Then about one hundred and eight miles to the north, it is again joined by the Atbara flowing from the Eritrean highlands. It then makes one gentle loop southwards then northwards, crossing the border at Wadi Halfa into Egypt where it is ushered gently to its delta on the Mediterranean. There, the Nile completes its full length estimated at about 4,180 miles from the Jinja exit.

For purposes of international legal and policy perspectives of the Nile basin there are further geographical-cum-hydrological facts that should be assembled or underscored. These include, especially the volume of water each of the riparians contribute to the Nile which amount might be taken into account in the consideration of how much water a riparian might properly abstract or divert for its national use. In terms of proportions, Gamal Moursi Bard of Egypt gave the estimate that of the total annual Nile discharge 84 per cent is contributed by Ethiopian rivers and only 16 per cent comes "from the Lake Plateau of Central Africa".[11] That

---

10. Garretson, "The Nile Basin" in Garretson, Hayton and Olmstead The Law of International Drainage Basins (Dobbs Ferry, N.Y.: Oceana Publications, 1967) pp. 256, 258.

11. Bard, G.M. "The Nile Waters Question: Background and Recent Development" Revue Egyptiene de Droit International No. 15-1959, p. 2. This nearly agrees with the figure given by Ethiopia as 85%. See The Ethiopian Herald (Addis Ababa) 21st May 1978 or Camponera, supra note 1.

is to say, 16 per cent would be the total contribution to the Nile anywhere south of Sobat-by Uganda, Zaire, Kenya and Tanzania. Garretson, on the other hand, offers the estimate at the peak of its flood, (April-Sept) the Blue Nile alone supplies 90 per cent of the water passing through Khartoum, but that in the low season (January-March) it provides only 20 per cent.[12]

Generally, one might submit that these figures are both too broad and vague. However, in terms of proportions they are illustrative. At this point we could probably content ourselves with the estimate that the "Lake Plateau of Central Africa" contribute between 15 and 25 per cent of water flowing north of Khartoum while 75 to 85 per cent is contributed by Ethiopia.

To Egypt as a lower riparian who depends on the Nile waters for its survival the contribution from Lake Victoria must be minute, relative to what comes from Ethiopia, on an annual basis. However, the Lake Plateau water is of a major advantage in that it is reliably steady throughout the year because of the nature of the storage and the control of the Owen Falls Dam.

One commentator has pointed out that it was because of the imbalance in the annual flooding, due to the Ethiopian contribution, that Egypt decided to construct the High Dam or Sudd el Aali at Aswan to regulate the supply and to provide over-year storage for Egypt rather than her dependence on the remote reservoirs of Lake Tsana and the Central African lakes.[13] On the same pages, the source points out that Sudan had preferred regulation of the flow of Nile Waters by a series of smaller dams rather than the Aswan model which would, in any case, only assure steady supply to Egypt (and not Sudan) and also where the reservoir would extend into Sudan to flood the town of Wadi Halfa. But one has to keep in mind that beside the flow control, the dam was also to be used for hydro-electric power generation to the tune of ten millions of KWH. Finally, the Egyptian interests prevailed, and the dam was constructed and completed between 1961 and 1964.

All environmental effects of the dam aside, how the regulation of flow by the Sudd el Aali has helped Egypt meet the over-year irrigation needs it desired is a fact that should be ascertained because it may have

---

12. Garretson op. cit. p. 259.

13. Batstone, R.K. "The Utilization of the Nile Waters" International and Comparative Law Quarterly Vol. 8 July 1959 pp. 523-525.

a bearing on Egypt's dependence on the waters of Central African Lakes at present. Of course, it should be pointed out, too, that the volume flowing out of Ethiopia also depended on whether or not that country might also decide to use some of the water on its territory. Dante Camponera, who was FAO consultant in Ethiopia during that period, wrote simply that "Ethiopia intends to reserve for her own future hydraulic development plans a share of the Nile waters located in her territory".[14]

The Sudan contributes no water to the Nile. But apart from what it consumes for irrigation there is the volume "lost" in the Sudd zone. It might be asserted safely, too, that Uganda and Zaire also make fairly minute contributions but a share which, nonetheless, should be provided by the Hydrometeorological Survey and expressed as a percentage of the total contribution from the Lake Plateau of Central African. The rough estimate given above was that the Lake Plateau's contribution is between 15 and 25 per cent of the water flowing at Khartoum. That proportion we understand to include the contribution of Zaire, Rwanda, Burundi, Uganda, Kenya and Tanzania.

A conclusion was reached here earlier that, apart from precipitation, only the southern and eastern parts of Lake Victoria basin contribute its water. The Lake's contribution to the Nile is also easy to determine since it is the total discharge through the turbines and sluices at Owen Falls. Therefore, for purposes of policy in Kenya and Tanzania whole hydrological information should specify the exact proportion of the annual out-flow at Owen Falls which is contributed by Kenya and Tanzania, separately.

Let us emphasize here that we prefer that this line of analysis should use the proportions or percentage of the volume of water contributed, rather than the absolute quantity or volume. The reason is that when an upper riparian decides to abstract or divert the water of an international river basin flowing through its territory, any fear of deprivation or injury expressed by a lower riparian is clear when expressed in terms of proportions. This expresses the degree of any injury that may be alleged.

Thus, if for purposes of argument, Kenya's contribution to the outflow at Owen Falls is only 16 per cent. Then if Kenya decides to divert five per cent of that contribution and use it for irrigation the degree of injury or deprivation which Kenya would threaten on the lower riparians would be less than one per cent of the outflow at Owen Falls. This links with what we

---

14. *Supra* note 1 at p. 4.

shall discuss later, in that the law relating to uses of such waters is interested in the degree of injury or what is equitable - both of which are questions of relative proportions.

The final question that we should dispose of in this section is whether the Lake Victoria and River Nile system constitute one basin or not. A drainage basin has been defined as "The entire area, known as the watershed, that contributes water, both surface and underground, to the principle river, stream or lake or other common terminus".[15] Sometimes, instead of the term "watershed" the word "catchment" is preferred. But this does not alter the substantive meaning of the term basin.

In the Lake Victoria and Nile systems the situation presented is rather complex. While the River Nile and its tributaries flow directly into the Mediterranean Sea, Lake Victoria seems to present a sub-basin with only one eventual outlet into the Nile. Therefore, this writer would prefer a simple reference to Lake Victoria as a sub-basin of the Victoria and Nile basin system. The effects of regulation of the flow through Owen Falls, which we shall discuss later, makes the semi-autonomy of the Lake Victoria sub-basin particularly clear-as it should show that the waters of Lake Victoria can be managed within a semi-autonomous basin system. This point, in turn, might be the logic behind why the riparians of Lake Victoria, especially, Kenya and Tanzania, might have unique cluster of interests in the Lake, which interest could be poised against those of the lower riparians, especially Sudan and Egypt, in any attempt to work out an upto-date legal regime for the Victoria and Nile waters.

III. BACKGROUND TO APPLICABLE LAW.

A. Introduction

International law regarding utilization of natural resources shared by two or more states is a controversial subject area partly because of the value of natural resources in national policy and partly because states often invoke legal rules and principles favourably only if such rules are supportive of their national policy or diplomatic interests. The

---

15. International Law Association, "Uses of Waters of International Rivers" Report of the Fifty-Second Conference, Helsinki, 1966 p. 485. (Referred to as The Helsinki Rules).

danger in this bias is that it would blind the state invoking it to the possible injuries that the other states might suffer or possible compromise solutions where the situation is not one of zero-sum game. It is because of this kind of bias, too, that some states might argue that the law with regard to internationally shared resources is either uncertain or non-existent.[16] Such controversies often force legal analysis to go into great details to expound and appraise state practice over long periods of time; provisions of existing treaties; judicial opinions expressed by courts and tribunals; opinions and studies issued by international organizations; and views of scholarly commentators.

In this study we shall not undertake such a systematic analysis of sources of law or evidence of law as regards utilization of international rivers. Rather, this section will only highlight the applicable principles and rules as well as to point out those principles that have commanded acceptance by states whenever states decide to establish systems for rational use of the resources shared by two or more of them. In essence, the section is simply intended to provide a legal and conceptual framework within which the issues and problems pointed out in the last section as well as Section V, and the treaties on the Nile Waters examined in the next section, should be viewed.

B. Contending Interests

A drainage basin is international if it straddles two or more state territories or if it forms part of the boundary of states. It is, therefore a special kind of natural resource shared by two or more state; its "resource" character is given to it by the water which flows in the basin or river and in which the respective states share an interest for purposes of conservation, domestic and agricultural use, access and the prevention of disasters such as flooding. All these questions may arise on the use of a river because it traverses two or more states or because it flows along the territorial boundary of the states so that the jurisdiction of the states is along the thalweg.[17]

The problems for law may relate to the interests of lower or upper riparians of the basin and may involve the changes in either the quality or

---

16. See reference in UNEP/GC.6/19 of June 15, 1978 p. 99.

17. Where the boundary river changes its course a unique problem related to territorial boundary, rather than use of the water, may arise. See the Mexico and United States dispute over the changing boundary because of the "restless" Colorado and Rio Grande Rivers in Friedmann, Lissitzyn and Pugh, International Law:Cases and Materials (St.Paul, Minn.: West Publishing Co. 1969) pp. 268-270. Mueller, J.E. Restless River: International Law and The Behavior of the Rio Grande (El Paso: Texas Western Press. 1975).

quantity of the water which may arise from the activities or uses to which the the upper or lower riparian puts the water while the drainage passes through its territory. Let us explain these basic problems before going into the discussion of the legal principles and rules deployed by states in respective instances.

(a) Complaints by upper riparians: These very seldom occur but one instance would be where a lower riparian dams a river causing back-water effect and possible flooding on the territory of upper riparian. This is illustrated by the effect of the High Aswan Dam on Wadi Halfa in Sudan discussed earlier. Another example is the question raised on the possible relationship between Owen Falls Dam and the rising level of Lake Victoria discussed in Section V below. These may be classified as environmental or physical injuries on the territory of one state but arising from activities on the territory of another, in the present case, lower riparians.

(b) Complaint by a lower riparian, against an upper riparian. These complaints may regard qualitative changes in the water which amount to pollution detrimental to the interests of that riparian. These are probable instances as running water will conveniently carry away municipal or industrial effluents and relieve an upper riparian of the problem of waste disposal. A classic illustration of this kind of problem occurred in 1969 when an estimated two hundred pounds of pesticide endosulfan discharged upstream the Rhine River in West Germany, killed about one hundred tons of fish downstream and also messed up the water for the Netherlands downstream. Well before that period, the relationship between Mexico and United States was seriously strained because of the increasing salinity of River Colorado waters, arising from activities in the United States. With increasing industrialization such instances will begin to appear in the developing countries of Africa. Broadly speaking, this category of problems may be classified with (a) above as activities within a state that result in adverse environmental consequences on the territory of another.

(c) A lower riparian may complain that an upper riparian abstracts or diverts and uses such large quantities of the river water that the former is deprived of the quantity of water it needs for its own use. As evidenced in the Lac Lanoux arbitration, diversion of the water which is later restored to its course before the river reaches a lower riparian does not constitute a proper basis of complaint.

Irrigation by an upper riparian is likely to lead to complaints under this category. The presumption is not that an upper riparian may not use the water, if the lower riparian also needs some or vice versa, but how much of the available quantity of water either party should use given that the amount of water available is finite.

Because the "quantitative" question relates to consumption of a natural resource by the state on whose territory it is available at a given point in time the development of law has been influenced by the positions nation states take depending on their interests at that point and time. In the sub-section that follows we shall examine some of the international legal concepts that states have adopted with respect to rights to use internationally shared water resources.

Contending Theories of Rights to River Waters

There are four theoretical positions of legal rights which some states have adopted in their claims over rights to waters of international drainage basins. Detailed exposure of the theories, with historical developments have been done by some authors.[18] Therefore, in the present section a synoptic expose will suffice the purpose of providing context for discussion of the Nile waters.

(a) Territorial Integrity: This is the concept applied to a theoretical position analogous to the old common law doctrine of private water rights whereby a lower riparian claimed the right to demand continued natural flow of river waters but where that state, for its part, did not accept to permit the continuation of the natural flow of the river passing through its territory. This would apply to both the quantitative as well as the qualitative considerations. This theory, in its practical effect, leads to claim of rights without corresponding responsibility.

Although Lipper argues that "research discloses no modern authority who adopts the territorial integrity theory as a rule of international law"[19] there are two instances of national assertion of versions of the theory which should be pointed out. The first assertion was submitted by Egypt to the Nile Waters Commission appointed by Egypt and Britain (on behalf of Sudan)

---

18. See especially, Lipper, Equitable Utilization in Garretson et al, supra note 10 at pp. 18-40 on which of the discussion of this sub-section largely depends. See also Berber, F.J. Rivers in International Law (London, Steven and Sons, 1959), and the Helsinki Rules supra note 15.

19. Lipper, op.cit.

in 1920, to examine and propose the framework for continued use of the Nile water for irrigation in Egypt. Egyptian authorities submitted to the Commission that abstraction of the waters for irrigation in Sudan would deprive Egypt of the "undiminished natural levels....." of water to which Egypt was entitled. The commission, in its final report, rejected that position arguing that implementation of the theory could completely preclude development in Sudan,[20] and this, in turn, might put the viability of Sudan as a state at stake. This situation would be untenable in inter-national law or relations.

The second assertion is reported to have been made by Pakistan in its claims over waters of Indus River as against India. Theirs was a rather limited claim and may not extend to the territorial integrity theory as understood here. It was in response to the absolutistic position taken by India that it was under no obligation to share the waters of the Indus with Pakistan. Then the latter, for its part, involved the reverse position that it should continue to receive the benefit of such use and enjoy-ment of the water on terms similar to those that were applicable before partition of the states in 1947.[21]

The Egyptian situation was resolved when it entered into the 1929 agreement with Sudan, which agreement allowed for "apportionment" of the Nile waters so as to allow Egypt its "natural and historical rights" without impeding development in the Sudan. In this context the treaty was still loaded in favour of Egypt but, nonetheless, because it allowed for irrigation in Sudan it was a significant departure from the absolutistic position adopted earlier. Similarly, the Indo-Pakistan dispute was resolved through the treaty of 1960 whereby the parties agreed on the apportionment of the water according to a formular which took several factors into account.[22]

Let us observe here, finally, that in both instances the assertion reflected the political conditions of their moment. In large measure, the lower riparians were aware that they could not enforce their rights as asserted by means other than cooperation of the upper riparians or military invasions and occupation of the strategic territory of the upper riparians.

---

20. The Commission Report is Annexed to the letter of 7th May 1929 from Egyptian Government to the British Government, forming part of the 1929 Egypt-U.K. Agreement on Uses of the Nile Waters. The clauses referred to are in paragraphs 37 and 38. Text in League of Nations, Treaty Series Vol. 92 p. 44 or ST/LEG/SER.B/12 op.cit. at pp. 100, 104.

21. See Baxter, R.R. "The Indus Basin" in Garretson et. al., op.cit. pp. 443-453.

22. ibid. The text of the treaty is reprinted in ST/LEG/SER.B/12 op.cit. pp. 300-365.

In modern International relation the theory is not workable in absolute defiance of upper riparian.

(b) Absolute Territorial Sovereignty: Underlying this concept is a simple level of the theory that a state is free to use and dispose of the natural resources within its territory according to its needs and wishes and under no restraint whatsoever, from external sources. It asserts that a riparian state is free to dispose of the waters of an international drainage basin flowing through its territory but that such a state should recognize the rights of an upper riparian to use the waters in like manner and therefore it claims no right to continued flow from the territory of the upper state. Therefore, the state claiming the right, has a conflict vis a vis the lower, and not upper, riparian.

The notion of absolute sovereignty over natural resources on the territory of a state is recognized within the United Nations diplomatic lexicon under the title of "permanent sovereignty over natural resources" by which states mean complete freedom of action in determining the use of those resources for national development.[23] But this rule, which is designed to give greater latitude to the capital-importing countries as they choose options for their development, is understood to refer only to resources exclusively situatedwithin the given country. That is to say, application of the rule does not affect a state other than that which actually has economic operations on the territory of the state invoking the rule. A drainage basin flowing through two or more states would present a very different set of facts and circumstances and application of the rule would have implications different from those indicated above.

The theory of absolute territorial sovereignty, though very powerful, has been rarely invoked. The best known instance is the so-called Harmon Doctrine in 1895 when in a dispute over utilization of Rio Grande with Mexico the United States Attorney-General Judson Harmon declared that if the United States agreed to negotiate and allow a share of the water to pass to Mexico the latter requested, it would be out of comity and not any

---

23. The debate on this subject which implies also freedom to nationalize foreign interests in national public interest has been long and fierce but does not concern us here. For an early development on that, see Hyde, J.N.,"Permanent Sovereignty Over Natural Wealth & Resources." Am J'l Int'l Law. Vol.50 (1956) pp. 854-67. For a survey on the concept see Report of the U.N. Secretary-General, The Exercise of Permanent Sovereignty Over Natural Resources and the Use of Foreign Capital and Technology for Their Exploitation U.N.Doc.A/8058 of 14 Sept.1970. On permanent sovereignty and nationalization see Adede,A.O. 'International Law and Property of Aliens:The Older Order Changeth". Malaya Law Review Vol.19 pp.175-193 (1977).

legal obligation.[24] Occasionally, the United States invoked the same rule, in later years, in its water relations with Canada and Mexico but these were in rather restricted and diminishing degrees. In one detailed study Austin concludes that while the idea of cooperation between Canada and the United States within a joint commission was born at the same time as the Harmon Doctrine, the sense of cooperation shall prevail as the monument of wisdom while the Harmon Doctrine will "wither away".[25]

On the position of the United States, as original exponent of the rule, Austin's conclusion is largely borne out by the practice that with respect to the rivers it shares with Canada and Mexico, the United States has opted for treaties of cooperation as the approach for utilization of the waters. We can assume that the chief exponent dropped the principle it had popularized.[26]

As we noted above, India is another country that has involved the absolute sovereignty and that was in its claim over rights to Indus Waters. Again, when the proper framework, including external financial support for development of the basin, India agreed to drop its position of absolute sovereignty and signed Indus Waters Treaty and the Indus Basin Development Fund Agreement in 1960.[27] India has since entered into other cooperative agreements on utilization of internationally shared drainage basins, including the Agreements on Sharing of the Ganges Waters, signed with Bangladesh at Decca on November 5, 1977.[28]

The India, United States or any other state which invokes the rule of absolute territorial sovereignty were to argue specifically that in the

---

24. Opinions of the Attorney-General Vol. 21 pp. 274, 283 (1895) Washington, D.C: U.S. Government Printers.

25. Austin, "Canadian - United States Practice and Theory Respecting the Law of International Rivers: A Study of the History and Influence of the Harmon Doctrine" Canadian Bar Review Vol. 37 pp. 393-443 (1959).

26. See for example resolution to the Rio Grande question in Mueller supra note 17; the solution of the question of salinity of Colorado River in Brownell and Eaton, "The Colorado River Salinity Problem with Mexico" in American Journal of Int'l Law. Vol. 69 pp. 255-271 (1975) which discusses the 1973 treaty on "Permanent and Definitive Solution to the International Problem of Salinity of the Colorado River" In International Legal Materials Vol. 12 p.1105 (1973). On the U.S. Canada cooperation see Bilder, "Controlling Great-Lakes Pollution: A Study in U.S. Canada Environmental Cooperation," in Hargrove Laws, Institutions and the Global Environment (Dobbs Ferry, N.Y.: Oceana Publications, 1972) pp. 294-341, and Johnson "The Columbia Basin" on Garretson et.al. pp. 167-255.

27. For the Indus Water Treaty see 419 UNTS 125 (1962) for the Development Fund Agreement see 444 UNTS 259 (1962).

28. Reprinted in International Legal Materials Vol. 17, p. 103 (1978).

absence of a treaty they are under no obligation, then that would be a different issue. But that might also be based on the fact that even though there existed certain rules under general international law requiring an upper riparian to allow water to reach a lower riparian the rules were not widely enough accepted to endow them with general binding effect. Again, this line of argument is, however [illegible] obstructionist device [illegible] into assessment of international law by those who know that a universally accepted yardstick under such circumstances is hard to come by.

So we shall return to pick up this line of discussion in analysis of the theory of limited territorial sovereignty. It is sufficient to note at this point that the exponents of absolute territorial sovereignty have changed from absolute rejection of any arrangements that permits the lower riparian to have a share of the water They have later permitted arrangements within framework of treaties that permit continued flow to lower riparians.

(c) Community of Coriparian States: This theory suggests that the basin should be regarded as an economic and geographic unit irrespective of state boundaries and that the water is vested in the community at large to be divided among the coriparian states by agreement. The theory takes into account that as a hydrological unit the river ought to be managed as an integrated system because very often the ideal locations for construction of dam for storage, hydroelectric power, or flood control may not be within the state riparian in need of such structures. Thus the agreement may, in some instances provide for the construction of structure by a lower riparian in the territory of an upper riparian. And, depending on the end product of the structure so constructed, the agreement may include sharing of costs among the riparians. In some instance, the financing of the projects may involve external donors.

A number of agreements under this category readily come to mind. The first is the Indus Treaty which was broached with the aid of the World Bank and other foreign states. But this treaty is only important from the perspective of financing from a pool or fund as we saw earlier. The projects were largely within the territories of the party states. The second example is the Columbia River Treaty between Canada and the U.S. where Canada permitted the U.S. to use large areas of Canadian territory for storage of water and hydroelectric power generation.[29] The U.S. agreed to pay for such use

---

29. See Johnson supra, note 26 and Lipper loc.cit.

through the power used by Canada and whenever Canada did not use power to the extent it was entitled the U.S. would purchase the excess if Canada agreed. The third example is under the 1929 U.K. - Egypt agreement on the Nile Waters and the 1949 agreement between U.K. and Egypt on the construction of the Owen Falls Dam, both of which will be discussed in the next section. But the aspects that concern this section relates to the rights both treaties extended to Egypt. The 1929 agreement permitted Egypt to construct any works on the river in the Sudanese territory in the Nile or its tributeries or take any measures to increase water supply to Egypt and that any such works would be under direct control of the Egyptian Government. The Owen Falls agreement, for its part, provided for the stationing of an Egyptian resident engineer at the Falls to ensure that the proper flow level was maintained in the interest of Egypt.

Each of the three instances has only some attributes of the theory with the Columbia River Treaty being the clearly comprehensive one and the Nile waters one being the least useful example. It is the least useful example because it simply benefits one party and no reciprocity, which gives the Columbia one the clear communal characteristics. In ultimate analysis, the Nile waters provisions are only useful illustrations to the extent that the upper riparian agreed to accommodate the activities of the lower riparians in its territory. Otherwise, the Nile one belongs to the territorial integrity category. It should be pointed out, nevertheless, that because of the complexity of the Nile situation, the participation of international institutions such as FAO, UNDP, World Bank, WMO, among others, may be necessary in its comprehensive development and that might introduce the Nile more directly within the ambit of this theory.

The following three examples are a new generation all concluded in Africa and have fairly similar provisions as to the management of the river basins. The three agreements are: (a) The Convention Relating to the Development of the Senegal River Basin, signed at Bamako on July 26, 1963[30]; (b) Act regarding Navigation and Economic Cooperation among States of the Niger Basin signed at Niamey on October 26, 1963,[31] and (c) The Convention and Statute relating to the Development of the Chad Basin signed at Fort Lamy on May 22, 1964.[32]

---

30. Text repointed in Sohn, Basic Documents of African Regional Organizations Vol. III (Dobbs Ferry N.Y. Oceana Publications pp. 1015-1031).

31. ibid. pp. 1032-1044.

32. ibid. pp. 1045-1052.

There are two major features of these treaties which are relevant here. First, the contracting states agree to consult and inform other coriparians in "adequate time" with a view to informing them of projects intended to be carried out on the basin even if the project is to be carried out entirely within the territory of the respective state. In every case, it was made clear that the information and consultation is not to give the other co-riparian a chance to veto the intended project but to provide an opportunity for assessment of the possible consequences with a view to ameliorating any probable adverse effects, if any. At the same time, the parties agree to abstain from carrying out on the portion of the river within their jurisdiction, works likely to pollute the water. To some extent this set of features, since they refer specifically to limitations on activities within jurisdiction of the respective state, and exercised by that state it might be considered as an aspect of the limited territorial sovereignty discussed here below. However, the provisions imposing the limitation should be read together with the second feature of the treaties as discussed next.

That second feature relates to the establishment and functions of the Basin Commissions by each of the treaties. The Commissions have a general overseer function for the water resources of the basin and to provide information on systems of rational planning and utilization. The standard language in the three treaties is illustrated by Article 2 of the Agreement concerning the River Niger Commission which states, inter alia,

> (b) to maintain liaison between the riparian States in order to ensure the most effective use of the water resources of the River Niger Basin;
>
> (c) to collect, evaluate and disseminate basic data on the whole of the basin, to examine the projects prepared by the riparian states, and to recommend to the Governments of the riparian States plans for common studies and works for the judicious utilization and development of the resources of the basin.
>
> (d) to follow the progress of the execution of studies and works in the basin and to keep the riparian states informed, at least once a year thereon, through systematic and periodic reports which each State shall submit to it;
>
> .....
>
> (g) to examine complaints and to promote the settlement of disputes and the resolution of differences;
>
> .....

It is the convention on the Senegal that has the special provision empowering the commission to seek funds, on bilateral or multilateral basis,

for the promotion of development projects on the basin.[33]

In general, the fact that some twelve countries[34] in Africa cpted for these formulae for utilization of their shared basins should be a guidance for other states on the continent. However, even though the agreements have been brought into force and the institutions provided for are established, reports suggest that only the Senegal regime has made significant progress in implementation of its agreement. The Chad agreement has been imperilled by the political unrest in Chad but the situation with the Niger Commission seem more complex. Towards the end of 1978 the parties decided that the situation was so critical that "holding a meeting of the Heads of State to determine the future of the River Niger Commission is the only solution".[35] The Summit meeting was held on January 26, 1979 but no information has been published. Detailed studies of the successes and reasons for failure in the above examples ought to be done with a view to benefiting future endeavours. For the present purposes it is important to note that the coriparians decide a treaty framework which took into account a basin as an ecological unit the utilization of which should be managed jointly by a community of states.

(d) Limited Territorial Sovereignty: This theory is akin to, but does not extend as far as, that of "community of coriparians". It is akin to the "community of coriparians" notion in that it gives each coriparian a right to "reasonable" use of the waters of a river flowing through the states' territory. One important difference, however, is that the present theory makes no provision for sharing of any costs or benefits of projects for the management or utilization of the basin waters. In essence, the theory is opposed to that of absolute territorial sovereignty which rejects any consideration of the interests of other states and posits that even though the coriparians may neither have joint management nor share in the costs or benefits, they are under obligation to permit equitable and reasonable access to each co-riparian.

This is a significant departure from the theory expressed in the Harmon Doctrine. Like the "community of riparians" theory, it permits international cooperation and suggests that vagaries of geography, such as the

---

33. Article V 11 (g)
34. Membership in the organizations are as follows: Senegal Basin Agreement: Mauritania, Guinea, Senegal and Mali Niger Basin Agreement: Cameroon, Ivory Coast, Dahomay (Benin) Guinea, Upper Volta, Mali, Niger, Nigeria and Chad Chad Basin Agreement: Cameroon, Chad, Niger and Nigeria.
35. Communication to this author from the Director Federal Ministry of Water Resources, Nigeria by their letter FDWR/WR/S/57/Vol. 1/1187 of March 5, 1979 and an enclosed report CFN/06/13.

Egyptian situation of being both the lowest riparian as well as in the hot desert, should not necessarily militate for the extinction of that state. By the same token, it would be untenable if a lower riparian demanded an absolute right to all the water of a river and exclude the right of an upper riparian to a share of the water.

IV. A CONSOLIDATED LEGAL FRAMEWORK

In the foregoing discussions it was evident that the first two theoretical positions were rejected both, analytically and in state practice. The framework favoured for cooperation in the utilization of internationally shared resources, like an international basin can be summarised in form of two principles, namely, (a) A state should be the resources within its own jurisdiction but to ensure that activities do not cause injuries beyond its own jurisdiction; and (b) Coriparians of an international basin should agree on a system which permits each of the states an equitable and reasonable share of the resources.

Sic utere tuo: The rule expressed by principle (a) is an articulation of the age-old latin maxim: sic utere tuo alienum non laedas, (so use your own as not to cause injuries to others). This has been acknowledged as a rule of general international law to facilitate the principle of good neighbourliness and to prevent abuse of rights. We shall not go into elaborate discussion of the history of its usage but reference should be made to articulation of that rule in a few instance.

Perhaps the most widely quoted instance is that in the Trail Smelter Arbitration between Canada and the United States where even thoug the compromis was clear that Canada had accepted liability for damage caused by sulfur fumes to farms in the United States, the Tribunal saw it fit to state that "under international law,.... no state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein....."[36]

It has also found acceptance in a more than twenty-four different conventions and declarations of governments and international legal institutions within this century.[37] Of the international declarations one that has

---

36. United Nations, Report of International Arbitral Awards Vol. 3 pp. 1965-1966 (Herein after UNRIAA).

37. See Camponera, D.A., The Law of international Water Resources: Some General Conventions, Declarations and Resolutions adopted by Governments, International Legal Institutions and International Organizations of Management of International Water Resources (Rome: F.A.O. 1978).

become very popular was adopted as Principle 21 of the Stockholm Conference on Human Environment which states that:

> States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.[38]

This principle has been cited and referred to in several international instruments including article 30 of the United Nations General Assembly's Charter of Economic Rights and Duties of States adopted in December 1974.[39] More recently, identical wording was adopted as Principle 3 of the principles drafted by Intergovernmental Working Group of Experts on Natural Resources Shared by Two or More States and later forwarded by U.N. General Assembly to its member states for comment.[40] With specific reference to international rivers the principle was adopted by the well-known Helsinki Rules of 1966 where Article X stated that; "(1) Consistent with the principle of equitable utilization of the waters of an international drainage basin, a state

> (a) must prevent any form of water pollution or any increase in the degree existing water pollution in an international drainage basin which would cause substantial injury in the territory of a co-basin State, and
>
> (b) should take all reasonable measures to abate existing water pollution in an international drainage basin to such an extent that no substantial damage is caused in the territory of a co-basin State."[41]

It seems clear that these rules of state responsibility are widely accepted and continue to be reflected in international agreements.[41(a)]

(b) Equitable Utilization: The second principle in the theoretical package already discussed requires that co-riparians allow one another reasonable and equitable sharing of the waters of the basin. The principle relates not only to qualitative aspects of the water resources as in the sic utere tuo rule discussed above, but it largely covers the wider question of sharing of the quantity of water for consumptive uses such as irrigation.

---

38. Report of the Conference is in U.N. Doc.A/CONF.48/14 of July 3 1972. See also Recommendations 51-55, 59 in that Volume for discussions on use of water resources.

39. U.N. G.A. Res. 3281 (XXIX) adapted on 12 December 1374 by roll-call vote of 120 in favour to 6 against with 10 abstentions.

40. See the Draft Principles adopted by Sixth Session of UNEP Governing Council in UNEP/1.G. 12/2 of Feb. 8, 1978 and the Councils decision in UNEP/GC 6/19 of June 15, 1978 pp. 99-101. For the UNGA decision see UNEP/GC.7/7 of Feb. 14, 1979, p.139.

41. See supra note 15 at 496-7.

41a. See Propositions VIII by Asian and African Countries cite infra note 46 pp. 229-230.

The concepts of "equitable and reasonable" utilization raise intractable problems for law since they do not lend themselves to formulation of precise rules. The cornerstone in the consideration of application of the concept is the idea of "conflicting needs" of the coriparians which compete for the limited quantity of water available. And this is the point that has been emphasized in the several inter-governmental and non-governmental international legal bodies which have made recommendations and draft principles to guide states on this issue. Again as was noted in the discussion of sic utere tuo[42] all these studies and recommendations have included the principle of reasonable and equitable utilization.

Of these recommendations, the work of the International Law Association and its draft articles adopted at Helsinki in 1966 (referred to as the Helsinki Rules) has commanded broad claim among scholars, governments and international organizations.[43] After stipulating in its Article IV that "each basin State is entitled, within its territory, to reasonable and equitable share in the beneficial uses of the waters of an international drainage basin", the Helsinki Rules proceeds in the following article, to parade of a list of factors that ought to be considered in order to satisfy conflicting needs in the waters of a drainage basin.[44] At their ninth session in 1967,[45] the Asian-African Legal Consultative Committee accepted the rules as a basis for discussion. After about six years of study the committee adopted factors that were substantially the same as those of Article 5 in the Helsinki Rules. These were reflected in the Committee's Proposition III which we quote here in full:[46]

> 1. Each basin state is entired, within its territory to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.
>
> 2. What is reasonable and equitable share is to be determined by the interested basin states by considering the relevant factors in each particular case.

---

42. Componera, supra. note 37.

43. See ibid; Bilder, "The Settlement of Disputes in the Field of the International Law of the Environment" Academy of International Law, Recuei des Cours Vol. 1-1975 pp. 141-183; International Law Commission, Legal Problems Relating to the Non-Navigational Uses of International Water Courses (Twenty-Sixth Session) U.N. Doc. A/CN:4/274 (Vol. II) of March 25, 1974.

44. supra. note 15 at p. 486.

45. Asian-African Legal Consultative Committee, Report of the Ninth Session in New Delhi, 1967 (Published by the Committee Secretariat in New Delhi) Chapter V pp. 51-59. However, there was one reservation expressed by the Pakistani delegate who said that the Rules were drawn up by European lawyers who were unaware of Afro-Asian problems ibid. pp.55-56. But it ought to be pointed out that out of the 36 members of the Drafting Committee of ILA 9 were from Afro-Asian countries. Out of the 9 there were 3 Pakistanis, 3 Indians, 2 from Sudan and 1 from UAR. See supra note 15 at pp. 532-3. No reservations were expressed in discussions which followed the Article.

3. Relevant factors which are to be considered include in particular:

a) the economic and social needs of each state, and the comparative costs of alternative means of satisfying such needs.

b) the degree to which the needs of a basin state may be satisfied without causing substantial injury to a co-basin state.

c) the past and existing utilization of the waters.

d) the population dependent on the waters of the basin in each basin state.

e) the availability of other water resources

f) the avoidance of unnecessary waste in the utilization of waters of the basin.

g) the practicability of compensation to one or more of the co-basin states as a means of adjusting conflicts among uses.

h) the geography of the basin

i) the hydrology of the basin

j) the climate affecting the basin.

These are all subject areas in which law has almost no competence at all. Indeed, it would seem that all that the lawyers did in drafting the articles was to recommend a comprehensive outline for negotiation. The suggestion is, therefore, that law is incapable of prescribing precise rules-qua-law, directing how the water should be divided but that by accepting these rules as binding on them the states accept an obligation to consult the coriparians and to inform them of its intention to use or consume a share of the basin water. Then every instance of a basin should be treated according to its unique circumstances.

It is that last sentence that carries the cornerstone of regulation and management of internationally shared drainage basins: the obligation to inform and consult with coriparians on intended projects on utilization of the basin. None of the factors listed above is given any weight above others but the set is to be considered as a package.

The question of what rules of international law are actually accepted as binding on states erga omnes is often a troublesome one. However, stipulations of Article 38 of the Statute of the International Court of Justice offers some guidance by showing the sources of law the

Court will apply."[47] Our analysis to this point shows that the above rules of law are widely accepted in state practice and in international legal institutions. The state practice have also been reflected in international agreements. As one author reports:

> There are now some 300 international agreements dealing with particular rivers, lakes or drainage basins,...../ _/ scholars.....have collated these provision and suggested certain broad features. Almost all of these agreements reflected acceptance in some form of the principle of equitable utilization. Over 60 of them refer to water pollution.....[48]

The main weakness in the foregoing legal system is that in the absence of a treaty framework the various interests and legal postions are heard only after a dispute has arisen. This then is the reason for the clear necessity for a treaty framework which provides for a system of exchange of information, research and consultation which have dispute - avoidance function, provided that the treaty includes an obligation to form and consult one another, as well as procedures for settlement of disputes.[49] A treaty for a specific drainage basin and including all coriparians would also stipulate criteria for resolving problems that are unique to that basin according to the factors relevant to equitable and reasonable utilization.

The postulates and rules outlined in this section will be taken into account as we review the agreements that have been concluded on the River Nile and Lake Victoria system.

IV: AGREEMENTS ON THE NILE AND LAKE VICTORIA WATERS.

(a) Introduction:

This section will outline the treaties that have been done on the use of Lake Victoria and Nile waters, but we shall limit ourselves to agreements dealing with consumptive use only - leaving out those on navigational

---

47. Article 38 states: (1) The Court whose function is to decide in accordance with international law such disputes as are submitted to it shall apply:
   a. International conventions, whether general or particular, establishing rules expressly recognized by the contesting states;
   b. international custom, as evidence of general practice accepted as law;
   c. the general principles of law recognized by civilized nations;
   d. subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law.

(2) This provisions shall not prejudice the power of the Court to decide a case ex aequo et bono, if the parties agree thereto.

48. Bilder, supra. note 43 at p. 168 (footnotes omitted)

49. For further discussion of the basis for obligation to inform and consult. See Utton, A.E. "International Environmental Law and Consultation Mechanism" Columbia Journal of Transnational Law Vol. 12 pp. 56-72 (1973).

uses as well as agreements using the basin or river courses purely for demarcation of boundaries and spheres of influence.[50] In discussing each of the treaties comments and questions will be raised as to their present legal status, such questions and comments being viewed in the context of the legal framework charted out in Section lll of this paper.

Certainly, one of the foremost considerations of the treaties on the Nile waters is that Egypt, as a desert state, has always depended on the Nile waters for its survival. But it is also clear that Egypt, as the lowest riparian of the Nile, depends on the cooperation of the upper riparians for an assured supply of water throughout the year. Indeed, this set of facts should be reflected in each of the agreements in that Egypt would be expected to be a party to each of the treaties, especially those dealing with consumptive use of the waters. However, the pattern does not readily reflect that.

There are about ten agreements dealing with consumptive use of the waters of the Nile and Lake Victoria. An interesting feature is that those agreements done before World War I show a dominance of the British rather than Egyptian interests. The United Kingdom, then the administering colonial power over Sudan, signed an agreement with Italy (1891), Ethiopia (1902) and the Independent State of the Congo (1906). There is a further agreement which some records show Britain to have signed with Italy (for Ethiopia) in 1925. Beyond these there was some change in participation after World War I, that is, when Britain become the Protectorate power over Egypt. From then Britain and Egypt signed all the agreements on the Nile Waters from beginning with the 1929 agreement which dealt with the Egyptian rights generally, vis a vis those of the Sudan, to the agreements for the construction and maintenance of the Owen Falls Dam done by exchange or note between 1949 and 1953.

The year 1953 is significant historically in that it saw the change in the government of Egypt-after the revolution by Nasser's men and therefore, a change in relations with Britain (even though the de facto break did not come till the Suez crisis of 1956). Sudan also became independent of

---

50. According to what this author could ascertain, the first ever "agreement" on the Nile dealt with navigational use of the river. It was expressed, in form of a unilateral declaration (Notification) issued by the Viceroy of Egypt, under the Ottoman Empire, on October 13, 1841, granting to foreigners the privilege of building ships for navigation on the Nile. For brief information on all the agreements, see Systematic Index of International Water Resources Treaties, Declarations, Acts and Cases by Basins (Rome: Food and Agricultural Organization of the U.N., Legislative Study No. 15. 1978) especially pp. 45, 129, 135, 137, 146-7, 157-161.

Britain in January 1956. It is after that time that we have the fourth and, apparently, final set of agreements signed on the Nile waters to date: Egypt and the Sudan signed an agreement on the utilization of the Nile waters in 1959 and followed it with a protocol establishing a joint technical committee in 1960.

In the rest of this paper the agreements will be discussed in the above order.

(b) The Pre-World War I Agreements:

(i) Italy and the United Kingdom signed a Protocol for the demarcation of their respective spheres of influence in Eastern Africa at Rome on April 15 1891. What interests us in the treaty is a provision in Article III which stipulates, inter alia, that "The Government of Italy undertakes not to construct on the Atbara any irrigation, or other works which might sensibly modify its flow into the Nile."[51] It can be properly assumed that the agreement, by its very nature, died with Italian and British colonial era in the region.

(ii) At Addis Ababa, on May 15, 1902, Ethiopia and the United Kingdom (for Sudan) signed a treaty regarding the frontiers between Anglo-Egyptian Sudan, Ethiopia and Eritrea. Article III of the treaty provided as follows:

> His Majesty the Emperor Menelek II, King of Ethiopia, engages himself towards the Government of His Brittannic Majestry not construct, or allow to be constructed, any work across the Blue Nile, Lake Tsana, or the Sobat which would arrest the flow of their waters into the Nile except in agreement with His Britannic Majestry's Government and the Government of the Sudan.

The views of the present government in Ethiopia towards agreements signed by the imperial government is not clear but one would expect that the binding force of such agreements cannot be taken for granted. It is particularly doubtful that the present government would agree to be bound by the treaty if the Haile Salasie's government did not accept them either. Dante Componera, who was a consultant to the Ethiopian government on international water resources, once observed that Ethiopia questioned the validity or binding force of the agreements for the following reasons:

---

51. See text in ST/LEG/SER.B/12 (1963) op.cit. pp. 127-128 for original text in French text, viz. "11,le Government Italien S'engage a,ne construire sur L'Atbara en vue de L'irrigation, aucun qui pourrait sensiblement modifier sa de'fluence dans le Nil.

1. The agreements.....between Ethiopia and U.K. have never been ratified. Customary rights which might appear from the behaviour between lower riparians and Ethiopia would not be binding on this latter country if a purely positivistic approach toward the interpretation of the sources of international law would be upheld.

2. Ethiopia's "natural rights" in a certain share of the waters in its own territory are undeniable and unquestionable. However, no treaty has ever mentioned them. This fact would be sufficient for invalidating the binding force of these agreements, which have no counterpart in favour of Ethiopia. An international agreement is a contract freely subscribed between states, between which the maxim do ut des (reciprocity) should automatically be a prerequisite for its validity. The existing agreements much resemble that Roman Law called pactus leoninus, in which one party reserved for itself rights and prerogatives leaving the party without counterpart, reciprocal concessions, or compensations. In Roman law such a pact would be null and void; it is likewise in international law. This is explanable by the international political conditions of Ethiopia in 1902.

3. The agreements were signed between Ethiopia and the UK (for Egypt and the Sudan). Since the latter countries either question the validity of their own water agreements.....Ethiopia, which had not one single benefit from them, had even greater reason for the claiming their unfairness and invalidity. The research for new agreements by Egypt and Sudan demonstrates the non-viability of these agreements.

4. The U.K. in 1935 recognized the annexation of Ethiopia Empire by Italy. .....U.K.'s recognition of annexation is an act which invalidated all previous agreements between the two governments. Ethiopia has never asked for renewal of the Nile agreements after such recognition.[52]

All the points listed here are important if only because they underscore the fact that Ethiopia did not, in 1950's, recognize the treaty as binding on them. That one might not find some of the arguments persuasive is a different matter. For example, there is nothing in international law which prevents any state from entering into a treaty which benefits only one of the parties. An extension of this point would perhaps include treaties which extend rights to third parties.[53] On the other hand, the argument about the British recognition of Ethiopian annexation might be the most forceful, even though generally, the legal consequences of hostilities or war is not always clear-cut.

It is important that since the 1902 treaty there does not seem to be any agreement between the lower, riparians of Sudan and Egypt, with Ethiopia. As noted above (and to be studied below) Egypt and the U.K. or Sudan signed

---

52. Componera supra. note 1 at pp. 13-14.

53. See Articles 36 and 37 of the 1969 Vienna Convention on the Law of Treaties. See also discussions referred to infra notes 70-72.

several agreements from 1929 but in no instance is Ethiopia a party, even though 85 per cent of the Nile waters originate from Ethiopia.

(iii) The United Kingdom and the Independent State of the Congo signed an agreement at London on May 9, 1906 to redefine their sphere of influence in Central Africa.[54] But they also included a provision which would protect the interest of Sudan over waters flowing down Albert Nile. Article III provided as follows:

> The Government of the Independent State of the Congo undertake not to construct, or allow to be constructed, any work on or near the Semiliki or Isango River, which would diminish the volume of water entering Lake Albert, except in agreement with the Sudanese Government.

Again we can assume that like the first British and Italian treaty of 1891, this one also died with the end of the British colonial era in the region. May be it would only have significance as an indicator of how far back the interests, of Sudan over the Nile water, have been protected. But it is unlikely that Sudan would want to rely on it for its Nile water rights or that Zaire would accept its binding force. Certainly, there is no reason why the two countries cannot conclude an upto date agreement rather than rely on a provision tied to a treaty on the colonial spheres of influence.

(c) A 1925 Disconformity:

Here is an interesting agreement, at the time it is reported to have been concluded. The agreement was by an exchange of Notes between Italy (on behalf of Ethiopia) and Britain, between December 14 and 20, 1925. According to Componera[55] and Garretson,[56] by that agreement, Italy recognized prior hydraulic rights of Egypt and the Sudan in the headwaters of the Blue Nile and White Nile rivers and their tributaries and engages"..... not to construct on the headwaters.....any works which might sensibly modify their flow into the main river....." The note adds further as follows:

---

54. Relevant articles in ST/LEG/SER.B/12 (1963) op.cit. p. 99.

55. Camponera supra note 1 at pp. 10-11.

56. Garretson, in Garretson et.al. supra note 10 at pp. 277-8. This author has not seen the text of this agreement, which both Camponera and Garretson say is in the League of Nations, Treaty Series authors are almost identical to the words, for the treaties discussed in this section. We are keen about the details of the 1925 treaty for what could be Italian relationship to Ethiopia at that point in history. For further questions read on.....

1. Note that His Britannic Majestry's Government have every intention of respecting the existing water rights of the population of neighbouring territories which enter into the sphere of exclusive outline and economic influence. It is understood that in so far as is possible, and is compatible scheme in contemplation should be so framed and executed as to afford appropriate satisfaction to the economic needs of these populations.

The first question which readily come to mind is why Italy could have signed a treaty on behalf of Ethiopia in 1925. Some sources say that this could have been on the basis of an 1894 agreement between Emperor Menelek II and Italy where there was a provision that Italy would oversee foreign relations of Ethiopia as in protectorates.[57] But there is no record that Ethiopia ever accepted such a provision. (Britain may have decided that it suited her to enter into an agreement with Italy even though under doubtful circumstances). It should be recalled, after all, that ten years later, Britain recognized annexation of Ethiopia by Italy. If that line of argument is correct then the agreement would be invalid.

But if the treaty was not found void for that reason, its validity would be questioned on the same basis as in the 1902 agreement discussed above. As pointed out therein, Ethiopia had maintained in 1950's that because Britain recognized Italian annexation of their territory all the treaties, pertaining to the two states or their territories became void and between them. On the basis of that Ethiopia would be expected to reject the continued binding force of the 1925 agreement.

(d) Post-World War I Agreements. (U.K. and Egypt)

(i) The 1929 Nile Waters Agreement: Background: The first important agreement on the Nile waters in the post-World War I period was done in 1929 between Egypt and the United Kingdom (acting for the Sudan and its Eastern African dependencies). That agreement was based on two Commission studies initiated by Egypt and which form an important background to the agreements. Therefore, it is important that those studies be pointed out before the agreements are discussed.

There had been several hydraulic projects proposed or done in Egypt and Sudan and these are discussed elsewhere.[58] But for the purpose of this study it is sufficient to take off from 1920 when the Egyptian

---

57. The point has been raised by my colleague, B.A. Godana of the Faculty of Law.

58. Garretson op.cit. pp. 264 et.seq.

Minister of Public Works issued a report on the scheme for control and use of the Nile waters. That report, which suggested five dams and reservoir on the Nile: at Jebel Awlia, Sennar; Upper Blue Nile; Lake Albert and the Sudd Channel Project; and Nag Hammadi, was strongly criticized and finally rejected by Egyptian government which, as we saw earlier, favoured one dam at Saad el Aali at Aswan.

The Egyptian government decided to appoint a Nile Project Commission that same year, and asked the Commission to "give to the Egyptian Government its opinion on the projects.....with a view to further the regulation of the annual supply to the benefit of Egypt and Sudan....." and more especially; "to report upon the propriety of the manner in which, as a result of these projects, the increased supply of available water provided by them will be allocated at each stage of development from Egypt and Sudan"[59]. These terms of reference are important to the extent that they show that Egypt was concerned about interests of the Sudan but never desired to know the best way of cooperating with either Ethiopia or the Central African States riparian to the White Nile of Victoria.

In its report the Commission pointed out, inter alia, that Egypt's rights were limited to a supply "of water sufficient to irrigate an area equal to the largest area which has been irrigated in any single year since the Aswan Dam in its present form was completed, and that Egypt has an established claim to receive this water at the particular seasons when it is required." They added further that the largest area to which Egypt might thus claim would be 5 milliard feddans which was under cultivation in 1916-17.[60]

This opinion is significant to the extent that it stipulated the amount of water to which, historically, Egypt was entitled to in the Nile waters. That is, later in this study it will be necessary to question what exactly is meant by "historic rights" of Egypt. But in the report of the Commission, generally, there was no agreement within Egyptian government where the matter got tied to the political future of Sudan. However, when the British Governor-General of the Sudan was assassinated in Cairo in 1924 the British government in Sudan acted tough and threatened to increase irrigation uses of water in Sudan.[61]

---

59. ibid. p.268
60. Quoted at ibid. There were three members of the Commission: A nominee of Indian Government (chairman), a nominee from Cambridge University; and a nominee of the USA government. The American nominee, called H.T. Cory submitted a separate report but in substance the details are not important for the present analysis.
61. See Batstone supra not 13 at p. 528.

As a result of the confrontations Egypt sought a fresh study for which a new Nile Waters Commission was set up in January 1925. The Commission consisted of a Dutch Engineer as an independent chairman, one British and an Egyptian members.Their recommendation provided the basis of the 1929 Nile Waters Agreement and was, in fact, annexed to the agreement. It is to the agreement we shall now turn and reference will be made to the 1925 Commission Report as appropriate.

The 1929 Agreement. The agreement was done by exchange of notes between Mohamed Mohmoud Pasha, the President of Egyptian Council of Ministers, and Lord Lloyd, the British High Commissioner in Cairo, on May 7, 1929 and came into force the same day.[62]

In the first paragraphs of the letter from Pasha to Lloyd, the Egyptian government pointed out, first that by conceding and accepting to enter into an agreement with Britain on utilization of Nile waters before political settlement was reached on the future of Sudan, Egypt reserved the right to renegotiate the issue at the time of consideration of the future of the Sudan. This point should be considered in light of the earlier point that Egypt attempted to resist an agreement with Britain on the matter until the political future of Sudan was decided but that after the 1924 assassination of the Governor-General, Britain threatened and forced Egypt to enter into agreement. But in that paragraph Egypt made it clear, as a matter of principle, that the 1929 agreement was to be temporary, and therefore, its terms should also be viewed as conditional on future political developments. This point is restated emphatically in the last paragraph of Pasha's letter where he wrote: "5. The present agreement can in no way be considered as affecting the controll of the river, which is reserved for free discussion between the two Governments in the negotiations on the question of the Sudan!" No doubt, the statement is important as it is the only point in the agreement which indicates for what duration the agreement was to remain in force.

Pasha submitted, secondly, that:

> 2. It is realized that the developments of the Sudan requires a quantity of water greater than that which has so far been utilized by the Sudan. As your Excellency is aware, the Egyptian Government has always been anxious to encourage such development and will therefore continue that policy and be willing to agree with His Majesty's Government upon such an increase of this quantity as does not infringe Egypt's natural and historical rights in the waters of the Nile and its requirements of agricultural extension.....

---

62. ST/LEG/SER.B/12 (1963) op.cit. p. 100-107.

On this paragraph some authors[63] have laid a great deal of emphasis on the reference to "Egypt's natural and historic rights" in the waters of the Nile. In the present analysis our view is that the significance of the paragraph is, in the fact, that Egypt recognized Sudanese right to develop and to use the Nile waters for that purpose. Certainly, that is a significant departure from the position Egypt had taken before the 1925 Commission, which position had been rejected as a negotiation for the right of Sudan to exist as a viable stage.[64] To the extent that Egypt has accepted the right of Sudan to increasing quantity of water for its development, Egypt had also accepted that the rights to use the different quantities of water would depend on the needs of the moment of negotiation. For these reasons, it seems that natural and historical rights would simply refer to the fact that in all history Egypt has had to depend on the Nile water for its survival. Indeed, that was a natural situation. The quantity would change with time.

That this should be the correct interpretation seem to be supported by the fact that the 1920 Commission was faced with the question of how much Egypt was entitled to it simply suggested that Egypt must claim the quantity necessary to irrigate 5 milliard feddans under cultivation in 1916-17.[65] There was no "natural" figure discernable over history. Supposing that Egypt was to claim that the quantity found to be highest in 1916-17 was the true natural and historic right, then even if its population changed, and therefore need for water became greater in quantity than that used in 1916-17, it would not change or request upper riparians to allow Egypt a greater volume of water. It is partly for this reason that the principle of prior appropriation which one commentator has suggested[65a] as an ideal interpretation of natural and historic rights is not really helpful. Prior appropriation would only refer to the precise quantity that had been appropriated and no more. Changing circumstances such as additional need would be negotiated for separately and according to what is equitable and reasonable at the time. Similarly, if for any reason additional quantities of water were available such as by draining the Sudds in Southern Sudan, then the division of that new quantity would be negotiated separately.

Egypt did not object to construction or irrigation in the Sudan, for use of the Nile waters as such. They did, however, insist on prior

---

63. Batstone supra note 13 at p. 529; Garretson op.cit. p.284 and Bard supra note 11 at p.4.
64. See discussions referred to supra note 20.
65. Reference of note 60 above.
65a. Batstone op.cit. p. 540.

consultation and, in fact, explicit agreement on what such a construction would entail. Thus, Pasha added in paragraph 4(b) of his letter to Lloyd that:

> Save with the previous agreement of the Egyptian Government, no irrigation or power works or measures are to be constructed or taken on the River Nile and its branches, or on the lakes from which it flows, so far as these are in the Sudan or in countries under British administration, which would, in such a manner as to entail any prejudice to the interests of Egypt either reduce the quantity of water arriving in Egypt, or modify the date of its arrival, or lower its level.

As between Egypt and Sudan, the situation would therefore seem quite clear - that the two countries would have to agree before Sudan could abstract the water of the Nile to the extent that would change the quantity flowing to Egypt. Sub-paragraph 4(c) of Pasha's letter stated that Egypt would carry out a complete study of the hydrology of the River Nile in the Sudan and that Sudan would provide all the necessary facilities and access. In this regard, Sudan permitted Egypt to construct and maintain, in Sudanese territory, any structures it may need for study of the hydrology of the river. To this effect, Pasha adds:

> (d) In case the Egyptian Government decide to construct in the Sudan any works on the river and its branches, or to take any measures with a view to increasing the water supply for the benefit of Egypt, they will agree before hand with the local authorities on the measures to be taken for safeguarding local interests. The construction, maintenance and administration, of the above-mentioned works shall be under the direct control of the Egyptian Government.

If "local authorities" in the preceding passage means local government units within Sudan, then the agreement certainly gave Egypt far-reaching and extra-ordinary rights within the Sudanese territory because the provision would suggest that Egyptian authorities were free to by pass the central government in Sudan, proceed to construct, maintain and administer the enclaves provided that the local government of the area does not object.

In the event of any dispute arising on the interpretation and application of the agreement the parties would, in good faith seek a mutually acceptable solution. If that fails, the matter would be referred "to an independent body with a view to arbitration." /para. 4(f)/.

The response by Lord Lloyd, also dated May 1929[66], confirmed the accuracy of Pasha's letter, as a reflection of the agreement they had

---

66. Text of Lloyd's letter is reprinted in ST/LEG/SER.B/12 (1963) op.cit. p. 107.

reached. He assured Egypt that the agreement was directed toward regulation of irrigation arrangements of the Nile and had no hearing about the status quo in the Sudan. Put with regard to the rights to the waters Lloyd repeated the vague phraseology when he wrote that, "His Majesty's Government.....have already acknowledged the natural and historical rights of Egypt to the waters of the Nile" he added,

> "I am to state that His Majesty's Government in the United Kingdom regard the safeguarding of those rights as a fundamental principle of British policy and to convey to your Excellency the most positive assurance that this principle and the detailed provisions of this agreement will be observed at all times and under any conditions that may arise."

To summarize the discussion of the 1929 agreement, the following conclusions may be suggested:

(1) That Egypt had overwhelming rights, as against Sudan, in the utilization of the Nile waters. This is evidenced by the rights given to Egypt, by the agreement, to conduct hydrological surveys as well as to construct, maintain and administer installations on Sudanese territory. It is further evidenced by the fact that explicit agreement with Egypt was necessary before Sudan could undertake any consumptive use of the waters.

(2) Quantity of water to which Egypt was entitled was not specified. Natural and historical right seemed only to underscore the Egyptian natural dependence on the Nile waters - a fact which was also historically correct. As to the specific quantities at given point in time, that would be subject to agreement, considering the needs of Sudan too.

(3) The agreement did not have general duration for its life. However, Egypt considered it was temporary and subject to renegotiation with the change in the political future of the Sudan. Sudan became independent in 1956 and in 1959 the two countries signed an agreement for the Full Utilization of Nile Waters (discussed later below).

The next partinent question is, then, what is the status of the agreement vis a vis the former British dependencies referred to in paragraph 4(b) of Pasha's letter quoted above? It is doubtful that the agreement was ever invoked and applied in Kenya or Tanzania to restrain any irrigation or other consumptive uses of the water. In Uganda, one could cite the Owen Falls Dam as the kind of installation envisaged in 1929. However, nowhere

in the Owen Falls Dam Agreement (discussed below) is there a reference to 1929 agreement but it is conceded too that Egypt was a party to the agreement.

With regard to Kenya and Tanzania specifically, the following conclusions may be suggested:

First, Britain never applied the treaty to Kenya or Tanzania and since independence we do not have any evidence that the government of independent Kenya desired that they succeed to the terms of the agreement. On that argument alone application of the binding force of the treaty on Kenya is highly doubtful. Tanzania for its part, we understand, had rejected application of the 1929 agreement to their territory citing the vital change in the political and economic circumstances (clausula) rebus sic stantibus.). Secondly, at her independence in 1956 Sudan, referring to the Nile waters agreement of 1929 contended that as an independent state it "was not bound to take over an Agreement to which it was not a party and which was anyway considered unfair"[66a]. Apparently Sudan held this view until it negotiated and signed a new agreement with Egypt in 1959, as will be seen later. In which case, if Sudan, which was a partial beneficiary to the agreement rejected it, then there is very little reason for assuming that the agreement would remain binding on Kenya and Tanzania.

Thirdly, the fact that Egypt had considered the agreement temporary and pending the determination of the political future of Sudan is important. If it was temporary for Egypt and Sudan, in terms of its application, then there is no reason to assume that it would have longer life for third states. Two key development should suggest that the force of the treaty had ceased: the first is the independence of Sudan as a final resolution on its political future, while the second one is the agreement of 1959 and the protocol of 1960 both of which should constitute latter definitive agreement anticipated in Pasha's letter. At least, there seem to be no reason to expect that the 1929 agreement would have any binding force to Kenya and Tanzania at the time of this writing.

(ii) The Owen Falls Dam Agreement: (1949, 1952 and 1953).

The agreement for the construction of Owen Falls Dam at Jinja was done by Britain, acting for Uganda, and Egypt by exchange of Note between the two governments. It was done in three forms: First, there was an

---

66a. See Bard, supra note 11.

agreement regarding the construction of the dam, pure and simple; secondly, there was an agreement on the granting of contract for the construction; and thirdly, there was an agreement on financial arrangements for the construction and maintenance.

The first of the three agreements above is the core of the formal treaty. The first letter, written on May 30, 1949, was by the British Ambassador at Cairo to the Egyptian Minister for Foreign Affairs.[67] In it, Britain had emphasized that it reflected completed negotiations and that the agreements was in accordance with the spirit of the Nile Waters Agreement of 1929..... The purpose was two-fold production of hydro-electric power for Uganda and the control of the flow of the waters of the Nile. It stated further that even though Uganda Electricity Board would invite tenders and place contracts for the construction, the specifications for the work had been prepared in full consultation and with approval of both, the Egyptian and Ugandan authorities. Thus, Britain here recognized the applicability of the 1929 agreement with respect to Uganda, which was to benefit from the hydro-electric power at the dam.

But Britain was going to allow for complete safeguard of Egyptian interests so that, indeed as the dam was to generate power for Uganda it was also to control the flow of water according to Egyptian needs. And the flow, which is a total of what goes through the turbines and what is allowed through the sluices, was to be supervised by Egyptian engineers resident at the dam. Paragraph 4 of the British letter stipulated as follows:

> The two Governments have also agreed that though the construction of the dam will be the responsibility of the Uganda Electricity Board, the interests of Egypt will, during the period of construction, be represented at the site by the Egyptian resident engineer of suitable rank and his staff stationed there for the purpose by the Royal Egyptian Government, to whom all facilities will be given for the accomplishment of their duties. Furthermore, the two Governments have agreed that <u>although the dam when constructed will be administered and maintained by the Uganda Electricity Board, the latter will regulate the discharges to be passed through the dam on the instructions of the Egyptian resident engineer</u> to be stationed with his staff at the dam by the Royal Egyptian Governments for this purpose in accordance with arrangements to be agreed between Egyptian Ministry of Public Works and the Ugandan authorities pursuant to the provisions of agreements to be concluded between the two Governments. (emphasis added).

---

67. See text of both letters in ST/LEG/SER.B/12 (1963) pp. 108-109.

Informal sources indicate that there is still an Egyptian resident engineer at the Owen Falls Dam to date. So it would appear that the agreement is still in force according to these terms. The British letter had made a provision that Uganda Electricity Board could take any action it considered desirable before or after construction of the dam provided that such measures did not infringe the requirements of the 1929 Nile Waters Agreement, that is, without prior consultation and agreement with Egyptian government. Any dispute which could not be solved by negotiation or concilliation would be referred to arbitration in accordance with agreement by both parties. The reply by the Egyptian Minister for Foreign Affairs, dated May 31, 1949, confirmed the formal agreement and it came into force that day.

As provided for in the formal agreement, Uganda uthorities granted the contract for the construction of the dam. About ten companies were listed with their respective fees. These were forwarded to the Egyptian government on December 5, 1949; they replied indicating their approval on the same day and that also constituted an agreement.[68]

The final round of Owen Falls Agreement, concerned financial arrangements for the construction and was also done by exchange of notes. The first note dated July 16, 1952, was from the Egyptian Minister for Foreign Affairs to the British Charge' d'Affaires at Cairo.[69]

What seems apparent in the Egyptian letter was that the emphasis was on the value of the Lake Victoria, at whose outlet Owen Falls Dam was to be constructed, as storage of water for Egypt. The carefully worded undertaking were as follows:

> The Royal Egyptian Government
> (i) Will bear that part of the cost of the dam at Owen Falls which is necessitated by the raising of the level of Lake Victoria by the use of Lake Victoria for storage of water.

The ordinary meaning of this provision would suggest that the engineers who designed the dam anticipated that as a result of the construction of the dam, the level of the Lake Victoria would rise beyond its regular level. Presumably, this would be because of the very nature of the "storage" function of the dam which might cause back-water effect, depending on how close to the natural lake the dam is built. The implication, it seems, is that the construction of the dam and the storage function, would effect the natural out flow from the lake, temporarily or permanently. The consequence of that factor could be numerous.

---

68. See ibid pp. 110-111.
69. See text ibid pp. 114-115.

Egypt undertook to compensate those around the Lake Victoria that might be affected by the change in the level of the lake waters. The second paragraph of the letter said that the Royal Egyptian Government

> (ii) Will bear the cost of compensation in respect of interests affected by the implementation of the scheme or, in the alternative, the cost of creating conditions which shall afford equivalent facilities and amenities to those at present enjoyed by the organizations and persons affected, and the cost of works of reinstatement as are necessary to ensure a continuance of the conditions obtaining before the scheme comes into operation, such costs to be calculated in accordance with the arrangements agreed between our two Governments.

The ensuing paragraph suggested further that the flow of water through the dam would be controlled for purposes other than hydro-electric power generation. The Egyptian government specified that there would well be occasions when the flow control could be done to the detriment of electricity supply to Uganda. For that purpose Egypt agreed "to pay to the Uganda Electricity Board the sum of £980,000 as compensation for the consequential loss of hydro-electric power, such payment to be made on the date when power for commercial sale is first generated at the Owen Falls Dam." It might be concluded that the "storage" function for water as needed by Egypt, would determine the allowable flow through the sluices as well as the turbines. If that argument is supportable, hydrologically too, then it must be concluded that Owen Falls Dam was built more for the advantage of Egypt than for Uganda. That would justify Egypt's acceptance to pay compensation as stated in the paragraph quoted above. Egypt went further and stipulated the conditions resulting from rising level of the lake which would be constructed as their responsibility. Thus, in conclusion, Egyptian government agreed "that for purposes of calculation of the compensation under the provisions of sub-paragraph (ii), all flooding around the Lake Victoria within the agreed range of three meters shall be deemed to be due to the implementation of the scheme. In his response of January 5, 1953 the British Ambassador concurred in the obligation undertaken by Egypt, and the Owen Falls Dam was commissioned in 1954.

What may be surmised from the substantive provisions of the treaty is that the regime worked well if it provided Uganda with the hydro-electric power they needed and also if the storage function in the interest of Egypt continued to the latter's satisfaction. It is also safe to assert that the agreement remained binding upon Uganda whatever the change of government so long as Uganda continued to enjoy the power-supply provided that there was no new agreement on the subject and neither party has renounced this agreement.

Egypt has a further obligation which she accepted vis a vis the other two riparians of the Lake: Kenya and Tanzania. That is, in event of any physical or environmental change suffered on the territory of the states around the Lake resulting from rising level of the Lake, Egypt would pay compensation. There does not seem to be any event that has changed the binding force of that obligation even though Kenya and Tanzania have since secured their independence from Britain. The important consideration is simply that the rising level, if any, must be established to have been caused by implementation of the Owen Falls scheme, as stated in paragraphs (i) and (ii) of the Egyptian letter.

That Kenya and Tanzania, after their independence may not have acceded to the Owen Falls Agreement is not of any legal consequence as regards the obligation Egypt undertook towards the two states under the Owen Falls Agreement. In international law treaties are generally res inter alios, that is, binding only among parties. Thus, treaties do not impose obligations on the third parties.[70] However, a treaty may include third-party beneficiary provisions. This age-old practice has been outlined in the 1969 Vienna Convention on the Law of Treaties where Article 36 states that:

> (1) A right arises for a third state from a provision of a treaty if the parties to the treaty intended the provision to accord that right either to the third state, or to a group of states, to which it belongs, or to all states, and the third state assents thereto. Its assent shall be presumed so long as the contrary is not indicated unless the treaty otherwise provides.[71]

It seems, therefore, that under the Owen Falls Dam Agreement, Egypt and Uganda might be under obligation to compensate Kenya and Tanzania in case the latter states suffer environmental injuries caused by operation of the Dam. The law of treaties requires, further, that should Egypt and Uganda decide to modify or revoke the stipulations relating to these third

---

70. The general rule of pacta tertiis nec nocent nec prosunt is expressed in Article 34 of the Vienna Convention on the Law of Treaties.

71. An identical text with commentary detailing the background to the provision is in United Nations, Official Records of the United Nations Conference on the law of Treaties; First and Second Session, Vienna 1969. A/CONF/39/11/Add 2 (New York, 1971) pp. 47-49. (art. 32).

party rights, they are under obligation to seek concurrence of Kenya and Tanzania.[72]

(iii) Agreement for Co-operation in Meteorological and hydrological Survey-1950

During the negotiations and exchange of notes for the agreement on the Owen Falls Dam, the Egyptian government saw a need for research, observation and recording of meteorological and hydrological data from the basin of East African Lakes including Lake Victoria. This was the subject of another agreement done by exchange of notes between Egyptian Ministry of foreign Affairs and the British Ambassador in Cairo, (for Uganda) before the one on Owen Falls Dam was completed.

The substance of the agreement was contained in the Egyptian letter to the British Ambassador on January 19, 1950[73] and it did indicate the degree of cooperation which Uganda authorities had promised to Egypt because the data would help Egypt determine the amount of water it could expect from these upper reaches of the Nile. According to the letter, Ugandan authorities had agreed to establish data collection posts to the extent that was marked in an enclosed map. But that number of posts would not be varied without prior consultation with the Egyptian Ministry of Works.

Further, it had been agreed that the Resident Egyptian Engineer at Owen Falls Dam and his assistants would have access to all the posts situated in Uganda. The intention was that they would carry out periodic inspection of the post "to assure themselves that the posts are being satisfactorily maintained and the observations regularly collected". Egypt would contribute toward the expenses incurred in obtaining and calculating the hydrological and meterological data to an amount to be agreed upon, but, in any case no less than £E.4,200 and no more than £E.4,500. The project for which the agreement was done was decidedly a long range one because the letter provided for construction of an evaluating station. Before the station is readied, the data would continue to be sent to Egypt for evaluation. The British reply, dated February 28 1950, confirmed Uganda's undertakings as outlined in the Egyptian note. The agreement entered into force on March 1st, 1950.

---

72. For background to the law of treaty requirement that "when a right has arisen for a third state in conformity with Article 32, the right may not be revoked or modified by the parties if it is established that the right was intended not to be revokable or subject to modification without the consent of the third states". See ibid pp. 49-50. But see discussions on the fluctuations in the level of Lake Victoria infra Section V (5).

73. Text in ST/LEG/SER.B/12 (1963) op.cit. pp. 112-113.

Perhaps the one interesting feature of the agreement was that Egypt was well set to use hydrological and meteorological data of the East African lakes well ahead of the countries within that catchment area. The agreement also gave them rights to take possession of the data and information which could also guide their policy towards the catchment of the lakes: Victoria, Kyoga, Albert and Edward.

It may be only by coincidence that later developments favoured Egypt as the United Nations Development Programme funded a project for Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Albert in agreement with six central African countries. The present Director happens to be Sudanese while his deputy is Egyptian.[74] However, this is not to suggest that the latter survey will replace the 1950 agreement which had no limits for its duration; but the two could cooperate.

(iv) Agreement for the Full Utilization of the Nile Waters - 1959

This agreement ushered a new era in the history of the Nile basin which has been analysed above. Although Egypt's protectorate relations with Britain is supposed to have ended when Nasser and his men took over in 1953 the clear break of the umbilical cord came with the Suez crisis in 1956, the same year that Sudan became independent. As noted earlier, Sudan in reference to the 1929 agreement particularly, had contended that as an independent state it would only accept the binding force of an agreement it had signed. The obvious implication was that Sudan was ready to negotiate a new agreement on the Nile waters and it was the ensuing negotiation that led to a new agreement.

Egypt and Sudan signed the agreement for The Full Utilization of the Nile Waters at Cairo on November 8, 1959.[75] The preamble states clearly that this agreement was to be different, in its intent and substance, from the preceding ones applicable to the two states. It stated that the 1929 Agreement had "only regulated a partial use of the natural river and did not cover the future conditions of a fully controlled river supply." On the other hand, the preamble argued, the full utilization of the Nile waters for the benefit of the two republic 'required' the implementation of projects for the full control of the river and the increase of its water supply and the planning of new Working Arrangements on lines different from those followed under the present conditions".

---

74. See supra note 8.

75. Text in ST/LEG/SER.B/12 (1963) op.cit. pp. 143-148.

A number of observations are apparent from these principles expressed in the preamble. First, to refer to "full utilization" and "full control of the river" when there are only two states involved in the agreement rather than all the riparians, especially the upper ones, seems patently anomalous. There is no evidence that Ethiopia, which contributes about 85 per cent of the gross annual flow at Khartoum, or the East African States, were invited in any of the negotiations. The two parties to the agreement were to be those that are simply recipients and users dependent on water from Central and Ethiopia. They needed the cooperation of those upper riparians if the goal of full control and utilization of the Nile waters was to be realized. The world of two countries seem to have been awfully small. Secondly, they declared the clear principle that the new agreement was not only more comprehensive but also different in spirit, from preceding ones especially the 1929 agreement. This suggests further, that according to the two countries party to the 1929 agreement, they no longer recognized its binding force. They were, therefore, beginning with tabula rosa as far as the utilization and control of Nile waters was concerned with regard to treaties between their states.

Substantively, the parties started by distinguishing their "established rights" to Nile waters. The established rights was to be the quantities of water used by either party before the control works established by the Agreement. For Egypt it was to be 48 milliard cubic meters and Sudan only 4 milliard cubic meters per year, in either case, measured at Aswan.

Let it be clear, though that the basis on which the respective volumes of water were determined are not clear from the text. But the two states negotiated and agreed on the proportions for their respective rights. Ordinarily, it would be assumed that they considered what would be equitable and reasonable under the circumstances, as we analysed earlier. Bard, looked at the relative figures for Egypt and Sudan and concluded that: "A State is at liberty to accept less than is due to it, should it so decide, for considerations of policy of which it is the judge. But these exercise of such a liberty in an international treaty.....makes it inadvisable to draw legal conclusions from such an instrument or to consider it a precedent in international law."[75a] He thus, accepted that there was really no historical or legal basis for the proportions set aside for Egypt and Sudan in this agreement.

75a. Bard, supra note 11 p. 20.

The control works under the Agreement were outlined in Section 11 of the agreement. Perhaps the most important features of this section are the provision for the construction of Sudd el Aali, or the High Aswan Dam at Aswan. Its important function was to store water for Egypt and to prevent the flow of excess volumes of water to sea, which Egypt would consider a waste. At the same time, the Dam would also cause back water flooding the territory of the Sudan, especially the town of Wadi Halfa, as pointed out here earlier. Under paragraph 6 of the section Egypt agreed to pay fifteen million Egyptian pounds to Sudan as full compensation for damages to the Sudanese property as may be caused by the storage of water at the Sudd el Aali Reservoir. Details of the modalities for payment of such compensations were outlined in Annex 11 to the Agreement. Sudan also undertook to transfer its population whose property were effected by the storage effect of Aswan from Halfa and the surrounding areas, prior to July 1963.

To enable Sudan to exploit its share of the water, the Agreement provided that she would construct Roseires Reservoir on the Blue Nile and any other works deemed necessary by the Sudan for that purpose. To Sudan, this was a major concession because, it will be recalled that during the negotiations leading to the 1929 agreement, Egypt has strongly opposed such works in the Sudan. Perhaps the changed position was because Sudan had undertaken not to exceed the volume stipulated in the Agreement. It is important to note further that Egypt had become nervous to the possible Sudanese intentions because in 1924 Britain had threatened to increase the irrigation and consequent consumption of water in Sudan. The political atmosphere in 1959 was different.

But it is still noteworthy that even though the two states could agree on the construction of the Rosieres Reservoir on the Blue Nile they never involved Ethiopia as a party to the treaty in order to assure themselves of the volume of water from Ethiopia.

The same attitude of neglect applied to the states of the Upper Nile Basin; this comes out clearly in Section lll of the Agreement. The emphasis in that Section was on water lost in the Sudds within Sudan. The Sudan government agreed to increase the supply of water flowing down the Nile and to prevent losses by draining the swamps. Central to this set of commitments is the well-known Jonglei Canal Project which would run from the village of Jonglei, in the south, to Malakal. Presumably, this would only open more agricultural land for Sudan. The two countries agreed to share the cost of the construction as well as the water released from the swamp.

The anticipated projects for the use of the Nile waters under the Agreement were to be backed by a system of technical cooperation between the two parties. Thus, they agreed in Section IV of the Agreement to constitute a Permanent Joint Technical Committee composed of an equal number of members from both Republics. The Committee would be responsible for supervision of all the working arrangements in Agreement as well as to carry out necessary hydrological studies to facilitate adequate policies. These would also include preparation of work implemented in the territories outside Sudan by agreement with their concerned authorities.

The general provisions in Section V broadened the aspects of the agreements dealing with third parties. Paragraph (i) commits the parties to a common front in any negotiation with such states. It reads:

> In case any question connected with the Nile waters needs negotiations with the governments of any riparian territories outside the Republic of Sudan and the United Arab Republic, the two Republics shall agree beforehand on a unified view in accordance with the investigations of the problem by the Committee. This unified view shall then form the basis of instructions to be followed by the Committee in the negotiations with the governments concerned.

The Permanent Joint Technical Committee is responsible for supervising the implementation of any agreement emanating from such a negotiation. Should any third state lay claim to any quantity of water which would alter the regime as viewed in the agreement, the two contracting states were bound under this agreement to study the claims and adopt a unified position as advised by the Permanent Joint Technical Committee.

It should be recalled that at the time of this agreement there was a nine-year old agreement between Egypt and Britain (for Sudan) for hydrological study of the basins of the central African lakes. Therefore, in terms of basic hydrological data on the Nile and Lake Victoria basins, the two states were evidently ahead of the other riparian states. The advantages in event of any negotiations anticipated in this agreement, would be enormous for Egypt and Sudan.

(v) The Protocol Concerning the Permanent Joint Technical Committee

Section IV (3) of the 1959 Agreement required the parties to issue an order for the formation of the Committee to fulfil the functions already analysed above. That purpose was met by a Protocol signed by the two states

at Cairo on January 17, 1960,[76] which was to be an integral part of the Agreement. Four members were appointed by either party. There was a stipulation in the Protocol that should there be a need to alter any aspect of it then that would be done by exchange of letters between the parties.

(e) Conclusions

Any of the foregoing treaties would be of interest to the extent that it is or is not in force at present. In every instance above we have analysed and drawn some conclusions as to what the present status of each agreement is.

It seems that important agreements on utilization of the Nile were not done until after the first World War. But even then, the 1925 agreement was an unusual one with doubtful validity at the time of its conclusion, but certainly void at present. The first full-scale agreement on the Nile came in 1929. Again the background of the treaty was so riddled with political complications that it evidently came as a temporary agreement to be replaced by a complete one in 1959. The latter between Egypt and Sudan is certainly in force between the parties.

Similarly in force too, is the Owen Falls Dam Agreement signed between Egypt and Britain (on behalf of Uganda). The obligation seems to have devolved on Uganda by virtue of its continued enjoyment of hydro-electric power from the Dam and because it has not renounced the treaty responsible for the generation of the power. Egypt, for its part is interested in the storage value of the Dam and Lake Victoria. It is because of that continued force of the treaty that we conclude that Kenya and Tanzania retain the third state rights extended to them in event of injuries resulting to rising level of the Lake only if the rising level is established to have resulted from the control of the Owen Falls Dam outlets. Under the treaties examined here Ethiopia, Kenya and Tanzania do not seem to be under any obligations as regards use of the waters flowing to Lake Victoria and Nile Basins. At least it is clear that there has been no agreement on the utilization of the waters of Lake Victoria as such. Therefore, there could not be any kind of obligation directly affecting Kenya and Tanzania. Similarly, we have not seen any treaty imposing any kind of obligation on Zaire, Rwanda and Burundi to the extent that they are riparians. All these states may, however, be under limited obligations only under general international law as discussed in Section lll above.

---

76. Text in ST/LEG/SER.B/12 (1963) op.cit. pp. 148-149.

V: RECENT DEVELOPMENTS

The last agreement on the Nile basin and with any relevance to Victoria catchment area was signed in 1960. Since then there must be several policy actions taken and implemented by the basin states without complete publicity. Among those there must be some policies involving consumptive uses of the waters to the extent that would affect the hydrological and meteorological regime of the basin and adjoining areas. We presume that such policy measures might necessitate consideration of a legal regime beyond what is analysed above.

In this section some of those policy statements and measure are outlined briefly. The outlined factors may then be viewed in the context of the technical aspects analysed in Section II and the legal framework discussed in Section III and the range of existing agreements. From that a final recommendation for future action may be made. No order of priority is attached to the following outline but they are discussed by the country where the policy is adopted:

1. Egypt. It can be assumed that the regular rise in population in Egypt may raise the country's needs for irrigation for food production beyond what was necessary in 1959. With Sudan, Egypt has probably agreed on quantities of water for its own use.

There is, however, one consideration that might drastically increase Egypt's need for water. In December 1975 Egypt opened six pipelines to take water across the Suez Canal to the Sinai desert for irrigation.[77] The project was originally proposed by UNRWA to provide 10,000 refugee families from the Gaza strip with livelihood but was never implemented by the United Nations agency. The project beginning in 1975 was supposed to commence with irrigation of some 5,000 acres to be increased later on.

How much water was needed for this and subsequent reclamation programmes was not published. But it is indicative of the increasing needs of greater quantities of water by Egypt. Old agreements and legal regimes may not cater for those kinds of needs, especially if there are increasing consumptive use of water by upper riparians.

From this point of view there may be the question of whether the Sinai desert is properly within the Nile catchment area. And if it is not then there may be questions about whether or not it ought to be of concern to the basin states.

---

77. See The New York Times Cec. 14, 1975 p. 28 and some comments in Batstone op.cit. p. 554.

At the general level there have been some press speculations about how extremely nervous Egypt has been about possible control of Uganda by unfriendly governments. The Nairobi-based Weekly Review. (April 27, 1979, p. 21) remarked that Egypt went along way in giving military aid to the armed forces during the liberation of Uganda in April 1979. The hypothesis develops that all the old animosities aside, Egypt believed that any Amin's resistance force backed by Libya with the support of the Soviet Union might put Egyptian interests in jeopardy, given Egypt's animosity towards Russia. This may be so. But the theory does not address the previously publicized reports that the Arab states supported Amin's regime through the eight years of reprehensible misrule.

Be that as it may, the speculations point to the fact that Egypt continues to be fairly nervous about the political regimes in the upper Nile basin states that might affect the security of water supply.

2. Sudan. Sudan has decided to undertake a major project called the Jonglei Canal construction. Essentially, the project consists of draining the Sudd area of Southern Sudan beginning from a village called Jonglei in the South to Malakal in the North. It would therefore be entirely within Sudanese territory but it will be of a major significance in that more water will flow to Egypt. And the rationalization is that this will stop the waste of water, through evaporation, as noted earlier.

The idea of the Jonglei Canal is an old one and has been a subject of some engineering and ecological studies.[78] However, in the past, two or so years its merits have been the subject of considerable controversy largely initiated by those who hypothesize that the project would be an ecological catastrophe.[79] Most of the commentators condemn the project for social and environmental problems it will cause for Sudan, particularly. Certainly, there are matters that those not resident in Sudan may be concerned with from a moral standpoint. However, there are also some hypotheses about the kinds of trans-territorial environmental problems that are envisaged and these are still only hypothetical and speculative. But they point at the reasons why there should be broad international concern with the project. Those problems may be listed under the following three broad categories:

---

78. See especially the five volume study The Equatoria Nile Project And Its Effects in the Anglo-Egyptian Sudan: Being the Report of the Jonglei Investigation Team (1954).

79. The Weekly Review, March 9, 1979 pp. 26-27; May 5, 1978 p. 2; May 12, 1978 p. 2; April 28, 1978, p. 24; African Business Nov. 1978 pp. 14-16.; Earthscan Briefing Doc. No. 8.; The Jonglei Canal: Environmental and Social Aspects by Osca Mann (An Environmental Liaison Centre Report Nairobi, August 25, 1977).

First, there is the hypothesis that draining the sudd will change the weather, including rainfall pattern in the entire region surrounding Southern Sudan. This is postulated on the proposition that the heavy evaporation from the sudd, discussed earlier, contributes to rainfall in the region.

The weather modification may or may not actually occur. But there have been no responses from Sudan to give contrary information, even though they may have carried out studies to challenge the hypothesis. But if the hypothesis was varified by actual results later on then the neighbouring states could argue that Sudan is liable for trans-territorial environmental injuries pursuant to the doctrine of sic utere tuo analysed above.

Secondly, it has been hypothesized that the combined volume of water, amounting to 20 million cubic meters, flowing down the Jonglei Canal and the regular flow of the Sobat River would change the rate of flow of the Sobat water as the river approaches Malakal. This, it is argued, would cause backwater-effect and flooding of the Sobat Valley in Ethiopia.

Oscar Mann, writing a report for the Nairobi-based Environmental Liaison Centre, said:

> A 'backwater effect' manifests itself as a damming-up of one river caused by a powerful flow across it from another river, as at the junction of two rivers. In this case the large volume of water flowing into the river Sobat from the tail of the Canal may cause this river to rise and accentuate the flood hazards upstream. The combined canal water and Sobat flow may cause a backwater effect on the Nile increasing flooding on the Ghazal, Jebel and Zeraf river systems.[80]

Again, how probable this threat is, remains uncertain. If it was to happen then the affected states might bring action against Sudan, or it might simply precipitate an international crisis between Sudan and the injured state(s).

The third hypothesis arises from the foregoing. It suggests that in an effort to reduce the threat of flooding as described above some observers have suggested that cooperation of Uganda would be sought in further control of out-flow at Owen Falls Dam. Such an action would promote the role of Lake Victoria as a storage-head in the interest of Egypt. As discussed earlier, Egypt resident engineers are presently placed at Jinja under the Owen Falls Dam agreement. Thus, the resident engineer would see to it that the sluices and turbine flows are controlled accordingly.

---

80. See The Jonglei Canal: Environmental and Social Aspects. supra, note 79.

The problem is that such a control would cause backwater effect, rising level of Lake Victoria and the attendant physical and ecological injuries to the states riparian to Lake Victoria. Some consequences of this set of problems are discussed in the section on Kenya below. Very simply, these problems related to whether rising level of Lake Victoria might entitled Kenya and Tanzania to damages under the Owen Falls Agreement or action pursuant to the rule of sic utere tuo in the general international law.

In every one of the three instances there would be international problems created which might pose serious threats to international peace or good neighbourliness. The consequences might be waste of resources in the process of negotiations, concilliation or arbitration. May be Sudan has revealed their studies countering these hypotheses at their secret ministrial consultations which occur annually especially with Kenya. But it is certainly warranted that such explanations should be publically clear among the governments to avoid the kinds of speculations about Sudano-Egyptian irresponsibility in undertaking a project with several international consequences without consultation with those states. Egypt and Sudan might even be accused of arrogance if they carried further their attitude that is manifested in the existing treaties especially the 1959 agreement and the 1960 Protocol whereby they totally ignored the upper riparians whose cooperation they should seek fo. continued water supply.

3. Ethiopia. The Ethiopian plans for use of the Blue Nile or Sobat waters for consumptive purposes are not available to this writer. However, there is evidence that Ethiopia was considering utilization of the Nile to the extent that Egypt found threatening to its interests.

Available reports on the issue are sketchy. According to the Egyptian newspaper Akhbar el Yom of May 13, 1978 "Egypt and the Sudan were studying with great interest feasibility studies being conducted by the USSR around Lake Tana, where about 85% of the Nile water originates. Egypt will not allow the exploitation of the Nile waters for political goals, and that it will not tolerate any pressure to bear on it or to forment disputes between itself and its neighbours."

The Ethiopian Ministry of Foreign Affairs issued a series of tense and non-concilliatory responses directed largely to Egypt and party to Sudan.[81] Essentially, their position was that even though international rivers had both

---

81. See The Ethiopian Herald (Addis Ababa) on May 14, May 21, and June 2, 1978.

international and national personality "Ethiopia has all the rights to exploit her natural resources". The statements also purported to remind Egypt that even though it received 85 per cent of the Nile waters from Ethiopia it had never shown friendship nor sought cooperation from Ethiopia but shown hostility to independent Ethiopia in every aspect of international existance In summary, the Ethiopian statement promised revenge to Egypt unless the latter could change its attitude and to seek cooperation.

Perhaps with this kind of exchange one might now want to ascertain the reasons why Egypt and Sudan had decided to ignore Ethiopia in the agreements for utilization of the Nile waters. As the Ethiopian statement points out, Egypt went ahead and built Aswan Dam which was to depend on the Blue Nile waters "without even consulting Ethiopia". In ultimate analysis then, the situation here illustrates a trend which develops if basin states do not consult with one another or develop a framework for cooperative utilization of the waters of an international river. By the time this hostile stage is reached it is almost impossible to establish a framework of cooperation.

4. Tanzania. The Republic of Tanzania is understood to be planning two major development projects utilizing the Lake Victoria Basin waters: One is to use the waters of River Kagera and the other is to use the abstract of the waters of Lake Victoria itself.

The project to use River Kagera waters was packaged in a treaty for joint management and development of the Kagera River Basin signed by Burundi, Rwanda and Tanzania in 1977.[82] They formed the Community of Great Lakes with headquarters at Gisenyi on Lake Kivu.

While the first objective of the organization is to generate electricity by damming Kagera near the Rusumo Falls the party states are also supposed to undertake major agricultural projects which would use the waters of Kagera.[83] Tanzania, for example, was set to begin construction of a 68 million dollar sugar project in the Kagera river basin. The project is expected to begin production in 1980 with a daily output of 250 tons. So the project would entail significant consumptive use of the water.

---

82. The official documents on the agreement have not been released to the public. See a brief report in The Standard (Nairobi) Nov. 9, 1977 p. 4.

83. The Standard (Nairobi) Oct. 17, 1978, p. 8. The project is financed by India, The Netherlands, two Indian Commercial banks, East African Development Bank, The Abu Dhabi Fund for Arab Economic Cooperation and the Tanzania Government.

AN OVERVIEW OF ORIGINS OF COTTON AND RESEARCH DEVELOPMENT

The origin of cotton is still uncertain (Purseglove, 1974). However, evidence emanating from phytogeographic studies suggests that Southern Mexico is the primary centre of origin of Upland cotton, Gossypium hirsutum (Vavilov, 1951). This is supported by Berger (1969) who pointed out that from Central America, Gossypium hirsutum dispersed to the Cotton Belt of the United States. The original forms were predominantly photoperiodic, fruiting only in short days, but as they spread into higher latitudes new varieties emerged probably through natural selection. It was to these varieties that the name "Uplands" became applied, in order to differentiate them from the Gossypium barba - dense, commonly found in coastal or lowland areas. Apart from Egypt and Sudan where the latter varieties are grown all cottons grown in Africa are Uplands, Gossypium hirsutum.

The introduction of cotton cultivation in the Lake Victoria Basin coincided with the initiation of the "Hut Tax" Regulations in 1900 and the completion of the Uganda Railway between Mombasa and Kisumu in 1901 (Hay, 1972). Cotton grown in the region originated from Uganda, a secondary centre of origin, where Gossypium hirsutum was introduced in 1903 (Jameson, 1970). In the past commercial cultivated varieties of cotton in the Lake Victoria Basin have been selected mainly from Uganda and United States, but now the variety collection has been expanded to include introductions from Tanzania, Central and West Africa, India and the U.S.S.R. The early commercial varieties;Egyptian Abassi, Mitafifi and Bukedi to Lake Victoria Basin have recently changed and UKA59/240 obtained from research breeding stations in Tanzania and Uganda is cultivated in the region. This variety is high yielding, resistant to bacterial blight and Jassid. Similarly, BPA variety has been introduced as a substitute for BP 52 from Uganda. Its lint is more superior to that of UKA59/240 and is suitable for manufacturing high quality cloth.

The necessity of radical change in varieties to correspond with the ecological conditions related to rainfall reliability, soil types, diseases, pests and new demands of the textile industry in the Lake Victoria Basin, means that we must make the widest possible choice of new breeding materials. In examining cotton materials for breeding, a very significant factor to be considered is the presence or absence of a diversity of hereditary forms. Heterogeneous materials possess the greatest possibilities for successful breeding.

The significance of exotic materials is that they perhaps provide

the most desirable plant physiological and morphological characteristics as well as crop quality which interest cotton breeders in their search to improve cotton productivity. To date, the introduced varieties of cotton require great care in breeding in order to retain all the valuable potential properties they originally possessed.

Kibos became the centre of research in the Lake Victoria Basin in 1951 with two sub-stations: Homa-Bay and Alupe. Initially, kibos Cotton Research Station was ostensibly geared to carry out research on agricultural enterprises including livestock, but now it concentrates on investigations on problems limiting cotton growth and yields. The cotton growing problems studied at the research stations at the moment include insect pests, plant diseases, rainfall reliability, soil fertility and technical services. But despite the applications of the recommendations of agronomic results, varied yields are still obtained thus indicating that the root of the cotton growing problems has not yet been identified by researchers. This failure suggests that research on cotton growing problems in the region must be intensified if the policy of increasing production and achieving self-sufficiency is to be a reality.

MORPHOLOGY AND DEVELOPMENT OF THE COTTON PLANT.

Cotton belongs to Malvaceae family and to the genus Gossypium. There are several species of the genus Gossypium, but the one grown in the Lake Victoria Basin is Gossypium hirsutum, commonly called American Upland Cotton. Gossypium hirsutum, is a perennial plant that is normally cultivated in the region as an annual crop. This is perhaps the case because cotton as a ratoon (ratton) crop is undesirable in a region where land is becoming a scarce resource, thus the same cotton field has to be used for growing subsistence crops. Secondly, cotton generally exhausts the soil nutrients, therefore a rattoon crop would be up economical due to low yield and high inputs. In view of this latter case, the farmers perhaps prefer crop rotation for the purposes of soil conservation, and producing enough food.

There are two major components of the cotton plant: the root system and stem. The cotton plant usually develops a comparatively deep root system, although the actual depth of penetration is a function of the age, size of the plant, the level of water table, the a ration and structure of the soil. On deep alluvial and irrigated soils, the primary root may penetrate up to a depth of approximately 3 metres when the plant becomes mature. Most of the lateral roots are found in the 30 cm of the topsoil, although the tap root may penetrate up to between 2 and 4.5 metres depending on the soil type and whether or not that plant is irrigated (Ngugi, et al, 1978). But plants growing in relatively wet soil or soil

with a compacted zone near the surface have roots concentrated within the 15-20cm of soil, while root systems developed in well-structured soils with sufficient moisture in the sub-soil extend to a considerable depth. In view of the foregoing discussion, pedological studies in cotton growing areas of the Lake Victoria Basin would be more meaningful if both top and subsoil are analysed for their chemical and physical properties. These soil properties should then be related to cotton yields.

Gossypium hirsutum consists of a very prominent, erect main stem (monopodial) containing true leaves and branches. There are two types of branch: onopodial vegetative branch arising from axillary bud and sympodial fruiting branch arising from extra-axillary bud. Vegetative branches are structurally similar to the main stem. However, the number of Vegetative branches from none to several, is primarily a function of the environment and partly determined by the varieties. In addition, the development of several vegetative branches are determined by wide spacing, high nitrogen content in the soil, available soil moisture and topping. At least 3-4 vegetative branches are desirable since they substantially increase the framework of the plant on which flowers and bolls develop. Flowers are produced at intervals along the branch; the first flowers are formed on the lowest branches; at the positions close to the main stem. From these flowers bolls develop and because they are produced in sequence, the bottom crop is often the earliest to mature and open becoming progressively later towards the top of the plant.

The discussion on the development of the cotton plant would be incomplete without a mention in passing of the germination phase. The germination under normal circumstances in the Lake Victoria Basin occurs after 2-3 days from the time of planting. From germination, the development of the cotton plant follows a time schedule which is determined by both climate and variety used. In the environmental conditions prevailing in the Lake Victoria Basin, the first flower unfolds 60-70 days after germination. The production of flowers continues for about two months, although only few bolls develop from those unfolding in the second month. On the other hand, the prevailing lower night temperatures experienced in Central and Eastern Provinces may delay the initial flowering by two weeks. This undesirable factor is uncommon in most cotton growing areas in the Lake Victoria Basin where the crop is confined to an elevation of less than 1500 metres above sea level.

In conclusion, the development of cotton crops from seeds depends on environment plant physiology and human influence. The location of the greater portion of the root system is mainly determined by the amount of soil moisture available. A part from this factor, cotton root growth may be limited by poor ploughing, hardpan, heavy clays (montmorillonit high salt content, gravel and sand strata which are common in some parts of the Lake Victoria Basin. These factors have not been thoroughly understood by the decision markers, thus contributing to low cotton productivity. Increased Cotton production in the Lake Victoria Basin will continue to be gloomy unless farmers understand the exact nature of their environment.

ENVIRONMENTAL REQUIREMENTS

Geographical differences in cotton production in the Lake Victoria Basin are probably determined by physiography, climate, soil and biological factors. Physiographically the region is varied (Fig. 2), ranging from piedmont plains to extensive plains, plateaus, escarpments and highlands with undulating topography. However, only climate and soil are discussed below.

Climatic Requirements:

The principal climatic features of interest to the agriculturist are the rainfall and the temperature because variations in these two parameters are undoubtedly linked, but not so closely as to forbid their consideration separately (Come and Lipscomb, 1972). Rainfall and temperatures in the study area are generally modified by the physiography and the proximity of Lake Victoria, but as with humidity and wind, seasonal variations in temperature are small (Obara, 1976). The rainfall regime of the Lake Victoria Basin can be summarized as one in which rainfall comes throughout the year, but in which two peaks of rainfall occur soon after the equinoxes under normal circumstances.

The high demands that cotton plant places on climate determine the areas where this crop can be grown commercially. Length of growing season, ranges in temperature, amount of sunlight, precipitation and other climatic parameters may limit the areas where cotton can be grown successfuly in the Lake Victoria Basin. As a result of these climatic limitation the cultivation in the area is mainly confined to an elevation of less than 1400 metres above sea level (Brown, et al, 1972). At any stage of its development the cotton crop is very sensitive to frost. On the whole, cotton is mainly a crop of the plains (Berger, 1969). Perhaps this explains why it was first planted in the Kano plains from where it diffused to other parts of the Lake Victoria Basin. The cotton experiment was initiated in the Lake shore Savanna and the High Rainfall Savanna chiefly in the heavy black cotton soils of the Nyanza

rift floor and the fringing lake lowlands (Ominde, 1968). In other countries cotton is grown commercially at altitudes ranging from Sea level to 1200 metres, some perennial varieties being found as high as 1800 metres above sea level. This latter case suggests that the present restriction of cotton to an attitude of about 1400 metres in the Lake Victoria Basin is tentative because with further hybridization some strains could easily be grown beyond this limit. But if this does happen, then there will be competition between cotton, sugarcane, tea, coffee and other perennial cash crops in the highlands. In this respect all factors being equal, cotton is likely to be more successful since its "gestation period" is less than a year. This situation can only be arrested by proper agricultural land-use planning. I have mentioned this point here simply because sugarcane whose market seems to be more lucrative is already encroaching into the cotton Belt (Fig. 3) and unless proper planning is carried out to reverse the situation, most farmers may abandon cotton cultivation.

The cotton plant makes little progress at temperatures below 15 ^{o}C. The low temperatures, particularly at night, result in slow vegetative growth, an extended period of flowering, and prevent ripening of the bolls to full maturity. In the Cotton Belt of the Lake Basin temperature is not a limiting factor unless cotton expansion goes beyond an elevation of 1400 metres above sea level. However, cotton had been tried successfully in the late 1950s and early 1960s in the lower areas of Belgut in Kericho District (Fig. 3) at perhaps a higher elevation than this.

Precipitation during the cotton growing season is of paramount importance. Cotton requires shorter growth period and less water than sugarcane (Fig. 4). The figure below shows that water required by cotton exceeds that of sugarcane only between June and August, thus giving the impression that it may be less risky to grow cotton than sugarcane. Although cotton can tolerate a wide range in annual precipitation, the distribution of this rainfall is the controlling factor in the production of cotton. Heavy rains and hailstorm are deleterious to young seedlings and mature bolls. During the period of vegetative growth moderate rainfall is best preferably at night so as to have maximum sunshine during the day. However, this is a minor constraint in the Lake Victoria Basin where rain often comes in the afternoon accompanied with heavy thunderstorms. Thunderstorms are useful in replenishing the soil with atmospheric nitrogen. Experiments carried out in the area show that maximum yields are only obtained if the seed is sown at the time which allows peak rainfall to coincide with the maximum

water requirement of the crop. Under normal conditions peak water requirement occurs between 70 and 120 days after germination during the time of maximum flowering and greatest leaf area, that is when the cotton crop is planted early in the long rains. A drier period is required to allow the bolls to rippen and to be picked. Sharp changes from drought to moisture are undesirable in cotton production. Severe drought and excessive rain after cause shedding and rotting of bolls. These are natural hazards which are extremely difficult to control, especially in the Lake Victoria Basin where the rainfall is relatively unreliable.

In order to afford adequate soil moisture for cotton crop, a minimum of 500 mm of rainfall is required annually, with 175-200mm being well-distributed over the growing season. Cotton does not fully develop in areas receiving less than this minimum, unless supplemented by irrigation. Rainfall in the various cotton growing districts of the Lake Victoria Basin differs perceptibly, but no area can be said to be marginal, as the rainfall is nowhere so low that agriculture under reasonable system would be pracarious, though ofcourse the Lakeshore and High Rainfall ecological Zones would greatly benefit from irrigation as has been confirmed by irrigated cotton at Ahero Pilot Irrigation Scheme. In the Lake Shore Savanna(1100-1200m) the average annual precipitation varies from about 750-1000mm, while the High Rainfall Savanna at 1200-1400m it ranges from 1000-1300mm per annum (Fig. 5). Nevertheless, these mean annual rainfall figures are not very meaningful for agricultural purposes. In agriculture what is more important is the time when the rain commences and its effectiveness after runoff, evapotranspiration and drainage, for growing cotton. The prime factor controlling the water balance of plant-soil environment is the water supply available to the plant (Hounm, et al, 1975). Below is the water balance equation:

$$P = Q+U+E+\Delta W$$

Where P= Precipitation or irrigation water added
Q= runoff
U= deep drainage passing beyond the cotton root zone
E= Actual evapotranspiration
ΔW= Change in soil-water storage.

During drought P.Q. and U become Zero, thus:

$$E = -\Delta W$$

However, drought in agriculture does not occur with the cessation of rain but rather when available stored water will support actual evapotrans piration at only a small fraction of the potential evapotranspiration rate. Studies by Woodhead (1968) show that annual evaporation of 2200-2400mm in the Lake Victoria Basin exceeds the total annual precipitation in most cases.

This is confirmed by Fig. 4 which shows that evaporation exceeds rainfall almost throughout the year. For a better understanding of the water requirements, there is need for considerable investigation on plant-soil-water relationship. It is only after doing this that ecological stress (drought) during the cotton growing cycle could be better understood and alleviated by irrigation. But irrigation performed without proper environmental studies carries in its train a host of problems, especially, increased salinity in areas where this has been unknown as is the case in irrigated cotton in Egypt. In addition, new breeding habitats for mosquitoes and snails may result in less salubrious ecological conditions due to increased malaria and bilharzia respectively, while the displaced population may find no suitable place for resettlement. These environmental consequences of irrigation may be far-reaching if no proper investigations are made during the initial stages of the Lake Basin Development Authority.

Soil Requirements:

Cotton grows on a wide range of soils, but it does best on a deep, friable soil with a good supply of organic matter and favourable moisture holding capacity. Sandy loams, loam and well-granulated clay loams are considered best for cotton cultivation. These soils occur in the Lake Cotton Area (Fig. 6). Free-draining alluvial soils are also suitable, but very sandy soils evident in some parts of the area make poor cotton land. Cotton grows over awide range of PH, but the optimum lies between pH 5.2 and 7. Strongly acid and excessively alkaline soils render the soils unsuitable. These latter limiting chemical properties of the soil are uncommon in the Lake Victoria Basin. However, cotton is an exhausting crop, thus the extension of cotton planting to new areas of poorer soil and lower rainfall in the Lake Victoria Basin may be expected to result in the destruction of soil structure and low potential yields unless proper agricultural practices are carried out. Nevertheless, there is no low potential land and there is very limited medium potential land in the area (Table 1).

TABLE 1: LAND POTENTIALITY IN NYANZA AND WESTERN PROVINCES ('000s HECTARES)

DISTRICTS	HIGH POTENTIAL	MEDIUM POTENTIAL	LOW POTENTIAL
Kisumu) Siaya)	432	29	-
South Nyanza	566	5	-
Bungoma	253	-	-
Busia	163	-	-
Kakamega	325	-	-

Two soil types, especially vertisol and nitosol, dominate most of the cotton growing areas in the Lake Victoria Basin. In South Nyanza and Kisumu-Siaya Cotton Belts, the heavy black cotton soil, which is infact a vertisol predominates with its characteristic swelling and self churning properties due to the presence of 2:1 clay mineral montmorillonite. According to Prentice (1972) the heavy soils are often the more naturally productive for cotton, although the small-scale farmer tends to avoid them because of physical difficulties in working them. By far the greatest problem on these heavy clays is that of water-logging and nitrogen deficiency, thus improving their structure, internal drainage and fertility through application of Gypsum ($CaSO_4 . 2H_2O$), fertilizers, manures, deep ploughing and other agronomic practices is prerequisite before realizing economic yields.

In Bungoma- Busia-Kakamega Cotton Belt the nitosol, which is a different soil type, prevails. The nitosol, though clay in texture behaves as a loam a property which is imported by cations of sesquioxides: Al_2O_3 and Fe_2O_3 aggregating the clay particles. These soils are deficient in phosphorus but they are better drained, thus higher yield is expected from them provided other conditions are favourable: Around Mount Elgon the soils are volcanic in origin with varying proportions of halloysites and allophanes as the dominant minerals. On the basis of the foregoing discussion, it is clear that the Lake Cotton Area has three contrasting soil types which could be examined under the "concept of soil productivity". Cotton certainly grows differently in different soils, but as site is part of the concept "soil", comparisons of cotton yield have to be drawn with caution (Prentice, 1972).

In summary, the discussion on the environmental requirements for cotton production highlights the need for re-examining the natural resources (climate, water and soil) for the purposes of proper recommendations and of increasing cotton productivity. Those areas which are swampy should be drained for cotton expansion, while tsetse flies in cotton areas such as the Lambwe Valley should be properly controlled because unhealthy people are agriculturally unproductive. Economically and demographically parts of the Lake Victoria Basin are still recovering from the aftermath of the tsetse invasion (Obara, 1973).

Key to Soil Map.

1. Dark Peaty loams.
2. Dark Red Friable clays.
3. Dark Brown Sandy Loams with Red Friable clays.
4. Stony Soils and Rock outcrops with other soils.
5. Dark Brown Sandy Loams with Yellow-brown Sandy Loams

6. Medium Humic Red Friable clays.
7. Red to strong Brown Friable clays.
8. Red Friable Clays with strong Brown Friable Clays
9. Grey Clays, Grey Compacted Loamy Sands, Peaty Swamps and Black clays.
10. Red-brown clays and Grey clay with Yellow-grey Loamy Sands.
11. Dark Red Friable Clays and Yellow-red Loamy Grits.
12. Peaty Swamps, Alluvium and Lacustrine Deposits
13. Black clays (in plains)
14. Dark Brown Sandy Loams.

CATEGORIES OF COTTON FARMING

Cotton is produced in Kenya under three main systems: individual small-scale farming system, group farming approach conducted under large-scale cotton schemes, and irrigation schemes.

(a) Individual small-scale cotton farming.

The individual small-scale farmers have been and continue to be the most important producers of the bulk of cotton in the Lake Victoria Basin and elsewhere in Kenya. However, cotton productivity from this sector is relatively low due partly to lack of full adoption of modern technology and agronomic practices. The Government, however, is determined to continue encouraging smallholder cotton production through the extension services, the cotton research programme and crop development projects. Unless high standards of husbandry are adopted, cotton gives a low yield (Table 5), making it unattractive to small-scale producers. However, it is not easy for the smallholders to adopt the high standards which are desirable partly because of high cost of inputs: fertilizers, sprays, labour and seeds. Cotton yields are depressed if planting is delayed, but early planting is not easy to be implemented by small-scale farmers because of the conflicts with labour demands of subsistence crops to which the farmers give higher priority. Cotton is regarded by the smallholders as being of secondary significance in the Lake Victoria Basin (Acland, 1971). Cotton should be sprayed and weeded several times but these operations are both ardous and expensive for the small-scale farmers.

(b) Group Farming Approach.

Several large-scale cotton schemes have been attempted in recent years in the Lake Victoria Basin as well as in Central, Coast and Eastern Provinces. The group farms vary considerably in size and methods of operation. However, all the group farms are characterized by a pooling of land and cooperation in carrying out some of the agricultural operations. One of the aims of pooling

the land is to facilitate the task of land preparation whether by oxen or by tractor. The group farms have been a means to test the improved techniques of cotton cultivation without risk to the participants because the latter could and, infact, did often retain their own cotton plots outside the scheme (De Wilde, 1967). But such cotton farm fragmentation consisting of at least two parcels of cotton fields both perhaps not situated on the homestead farm could result in inefficiency of management practices. At a distance of 1 Kilometre the decline in net return is large enough to be significant as a factor adversely affecting the prosperity of the farming population.....at about 3-4 Kilometres, the cost of operation rise sufficiently to be oppressive and seriously detrimental (Chisholm, 1968). This hypothesis needs to be tested in the context of cotton production in the Lake Victoria Basin. Although, in a traditional society, it is often easier to introduce new techniques through group farming approach than have them pioneered by individuals who may thereby become objects of envy and adverse criticism by others (De Wilde, 1967), experience with these large cotton schemes has been disappointing and no more schemes of this type are being recommended except the scheme at Lamu (Republic of Kenya, 1974). Group Cotton farms perhaps permit a more economical employment of the agricultural extension workers who are likely to provide more frequent advice and guidance to the farmers. Despite this interesting point the group farms have not become a permanent feature of the agricultural development in the Lake Victoria Basin. Problems have been encountered in the operation of group farming system in the region. Group farming approach often failed to be an important instrumentality in improving the production of cotton perhaps because the system tended to reverse the priority previously given to subsistence crops in the Lake Victoria Basin. Some farmers decided to plant the cotton block project to their own preferred crops (Republic of Kenya, 1977). Other reasons advanced for the unsuccessful experimentation with cotton block project in the region are: delayed land preparation, late release of seed, poor weeding, irregular application of insecticides and occasional hailstorms. Although group farms are intended to demonstrate the profitability of better methods of cotton husbandry, they have failed to encourage an increasing number of individual farmers to emulate these methods on their own holdings.

(c) Cotton Irrigation Schemes

Irrigated cotton has been tried at Ahero Pilot Irrigation Scheme and this has not been extended to the farmers in the Lake Victoria Basin. Yields were somewhat lower, ranging between 1400 and 2000 Kg. ha^{-1} in certain seasons due to the fact that no nitrogenous fertilizers are applied (Bradley, 1968). At present there is only one irrigated cotton at Hola. Table 2 shows that cotton yields at Hola Pilot Irrigation Scheme ranged from 926 kg. ha^{-1} in 1967 to 3181 kg. ha^{-1} in 1971. But individual yields range from 1500-4300 Kg.ha^{-1} with 85% of

of the farmers attaining yields between 2000 and 3500 Kg.ha^{-1} at Hola (Muturi, 1976). The high cotton productivity from individual fields is partly due to better management practices. From 1967 to 1974, there is evidence of smooth progress in seed cotton production at Hola, but this evidence is not obvious for size of land under cotton and seed cotton yields. Both hectarage and yield fluctuate perhaps due to differences in the amount of irrigation provided other factors remain the same. Despite any shortcomings, it is possible that the development of water resources for irrigation in the Lake Victoria Basin will boost cotton yields and production provided other factors are maintained.

Table 2. Progress in seed cotton production at the Hola Pilot Irrigation Scheme 1964 to 1974

Year	Hectarage under Cotton	Total Production (Bales*)	Yield of Seed Cotton (Kg/Ha)
1964	477	3032	1177
1965	499	4437	1646
1966	494	3296	1204
1967	500	2025	926
1968	484	4405	1683
1969	535	6065	2098
1970	573	6903	2230
1971	571	9918	3181
1972	700	10881	2843
1973	855	12200	2690
1974	856	12227	2685

Note: * 1 Bale = 185 Kgms.

Source:

HISTORICAL PERSPECTIVE OF COTTON PRODUCTION

The historical background to cotton production is well documented (Fearn, 1956, 1961, Hay, 1972 and Brett, 1973). Although cotton was introduced in 1904 (Burrow, 1975), the growth of cotton industry in the Lake Victoria Basin has not been impressive. Cotton growing was initially encouraged mainly to satisfy the needs of the railways, to facilitate an exchange economy, and to pay Government taxes (Fearn, 1956 and 1961). This section attempts to examine the ups and downs in cotton production in the Lake Victoria Basin at different seasons.

Cotton Season 1908-1922

In 1908, there was less cotton production in the Lake Victoria Basin first because there was a general lack of systematic help and encouragement by the Government. Secondly, the indigenous people were more interested in growing food crops first. Cotton cultivation is always an after-thought in the traditional agricultural system in the Lake Victoria Basin. The high priority given to subsistence crops partly contributed to the low cotton output despite efforts to promote its production by rigorous plans to exercise constant supervision of planting and weeding. Thirdly, the low prices also contributed to low cotton output in the region. Attempts to introduce cotton cultivation in Kano, Seme, Samia and Nyakach locations of the Lake Victoria Basin failed to materialize except in Samia and Kano (Hay, 1972). The 1914-1918 War augmented the problems of the cotton industry, resulting in the Kisumu ginnery operating under capacity during the first two years of the war and eventually stopped functioning in the next three years, although this cessation of activity was partly attributed to the prohibition of seed cotton imported from Uganda in 1920. Nevertheless, cotton production was obviously strongly influenced by the Government's policy. Perhaps the most important was lack of any real formulation of cotton price policy. Nothing was done about the crop until 1922, thus a favourable opportunity was missed since prices were high because of disease in the American yields and the Uganda industry was expanding rapidly (Brett, 1973), But in 1922, the change in Government's policy led to a revival, agricultural supervisors were moved into the Lake Victoria Basin, ginneries set up with official assistance and large quantities of seed distributed.

Cotton Season 1923-1938.

During the 1920s great efforts were made to introduce cotton in South Nyanza, Bungoma and Kakamega Districts, but they were unsuccessful chiefly because of the poor prices offered to the producers. Cotton was not only stagnant because of poor prices (van Zwanenberg and King, 1972) since the disappointingly low export, averaging only £3000 p.a. between 1923 and 1924 was attributed to the lack of cotton ginneries in the Lake Victoria Basin (Cone and Lipscomb, 1972). But cotton production has had a varied history owing to price fluctuations and preference of the smallholders for the production of food crops (Gibb and Partners, 1956). Moreover, it seems that the White Settlers in Kenya opposed the policy of encouraging the small-scale cotton growers (Brett, 1975) because the Lake Victoria Basin was the main source of labour for European plantation agriculture.

A more serious change in the Government's policy for cotton production was established between 1923 and 1926 when the first agricultural extension officers were involved in cotton development in the Lake Victoria Basin. An enactment of the Kenya Cotton Ordinance was formulated in 1923. Under the Ordinance the governor was authorised to formulate the rules controlling cotton industry. These rules controlled growing, marketing, ginning and maintaining quality of cotton. These stringent rules failed to materialize because of lack of any real formulation of cotton price policy, price fluctuations from 30 cents per 0.45Kg in 1923 to 12 cents per 0.45 kg. in 1927 became inevitable. In 1925 an Empire Cotton Growing Corporation expert visited the Lake Victoria Basin for the purposes of giving advice to the producers. However, it was realized that the region had less promise to produce very large quantities of cotton because of competing labour demands, poor communications, and lack of research facilities in the region. But the subsequent failure of American cotton crop caused a temporary rise in prices, which led to more confidence by the farmers to increase cotton production in 1978 and 1929. Furthermore, the farmers were encouraged by the Government sending administrators to discuss agricultural matters at "Barazas". This helped in the dispersal of agricultural information concerning agronomic practices. Despite these new efforts, world prices dropped in 1930, thus cotton production was depressed, although cotton received a tremendous emphasis due to locust invasion and famines in order to obtain cash to buy food. After the eradication of locusts, the excessive rains and hailstorms in 1931-1932 damaged cotton. From 1932 to 1938, cotton continued to suffer from fluctuating prices and occasional cold weather in some parts of the Lake Victoria Basin.

Cotton Season 1939-1954.

Between 1939 and 1945 cotton production declined in all the provinces due to the Second World War and Government's policy to emphasize on food crop production. Many farmers concentrated on growing cereals and oilseeds which were demanded greatly. Cotton production continued to decline after the war because of severe boll shedding in the Lake Victoria Basin. Between 1948 and 1950, the weather was favourable and the Government encouraged the producers by improving prices, storage and marketing facilities. During 1950-51, a further encouragement was given by research officers who improved cotton strains and farming methods. However, maximum cotton output was not realized due to excessive rain which made most cotton lands sudden with water in 1951. In 1952, cotton yield declined due to late planting and high incidence of American hollworm, Lygus and blackworm. These pests continued to affect cotton production in the Lake Victoria Basin until 1954.

Cotton Season 1955-1970.

During this period there was greater emphasis on agronomic and management practices supported by a quotation from Swynnerton (1955):

> There is little likelihood of being able to extend cotton growing to other areas. Intensive experimentation is in train on improved strains, cultural methods and pest and disease control, an officer being posted from the Empire Cotton Growing Corporation to help with this work. Production will mainly be stepped up through the efforts of increased staff proposed in this plan who will aim, by applying the results of experimentation and by securing better cultivation and increased average by African cotton growers, at doubling production.

Despite the emphasis on the application of science and modern technology in smallholder cotton production in the Lake Victoria Basin, yields are still low by any standard; partly because of low standard of husbandry. In 1957 the standard of cultivation deteriorated in the Lake Victoria Basin because many farmers were said to be lazy to pick the ripe cotton and so they left them to fall and rot on the ground. I strongly disagree with this view because the farmers were perhaps depressed by low cotton prices, dissatisfied with the organization of marketing and were not provided with insecticides. Thus, there was no short-cut for expressing their disappointment with the forced cultivation of cotton, but to leave the crop to decay in the fields. To confirm this, good results were obtained in the same year where cotton dusting with BHC and DDT was performed on selected smallholdings in the Lake Victoria Basin. Between 1961 and 1965 cotton became one of the leading crops in the region despite the environmental constraints: drought, pests and diseases. In 1970, problems of cotton seed distribution became serious in Nyanza. Areas growing BP 52 switched over to UKA 59/240 and other areas such as Kendu-Bay, Homa-Bay and Kibos zones grew these varieties for the reasons already outlined earlier in this paper under origins of cotton and research development.

Cotton Season 1971-1975

For the first time in the region, there was no free issue of seeds in 1971, instead sh. 5.00 per packet was charged and this was only enough to plant 0.4ha. Most farmers had no money and so they were loaned by their Cooperative Unions. From 1970 to 1972 cotton experienced several problems; less change in cultural practices, farmers preference to plant late and concentration on growing subsistence crops, lack of capital resources, poor organization in marketing arrangements, absolute lack of knowledge on the economics of farming and competition for labour among several farm enterprises. The seriousness of labour problem is well-illustrated by Kennedy (1964) who notes that:

> Since labour is the limiting factor, he concentrates on the relatively high returns to be derived form small inputs of labour on a large area, rather than the diminishing returns of high inputs on small acreage, this would seem to have an important bearing on the general level of husbandry that can be expected from the less affluent members of peasant farming community.

Between 1972 and 1975 cotton production experienced problems similar to those ones already cited.

Summary

Cotton production in the Lake Victoria Basin has been influenced by the Government's policy and indigenous agricultural system. Initially cotton growing in the region was encouraged as a cash crop to facilitate the introduction of an exchange economy, to satisfy the needs of the railways and to enable the smallholders to pay the Government taxes. Later cash obtained from cotton was used to buy food due to the famine conditions of early 1930s caused by locust infestations. During the Second World War the cotton industry suffered an eclipse due to Government's policy to encourage cultivation of food crops. After the War cotton seems to have been encouraged mainly in areas climatically suitable and where the smallholder's opposition was relatively less. Nevertheless, the small-scale cotton farmer's response throughout 1908-1975 has been a fluctuating one and cannot be said to be determined by price movement only. A more important factor has been the smallholder's preference for the production of food crops both for subsistence needs and for the sale of any surplus. Even in those areas of the Lake Victoria Basin where it would be more profitable to grow cotton and buy food requirements, the farmer's attitude that he is not going to buy what he can grow has perhaps led to his insistence to grow subsistence crops, particularly, maize (Z mays) even though the yields may be low.

PROBLEMS OF COTTON PRODUCTION:

With the recent cut off of imports from Tanzania and Uganda due mainly to political reasons, Kenya continues to import cotton from India and Argentina at an exorbitant price, Kshs 45 million p.a. In view of this observation and the current policy to impose higher import duties on imported textiles, there is no alternative but to focus more attention on achieving self-sufficiency in cotton production with a possible export rather than import overlap. To achieve this policy, several problems which have led to shortfalls in cotton production in the Lake Victoria Basin must be identified and solved. These problems are examined below.

Cotton Marketing and Pricing Policy

Marketing may be defined as the vital link to the cotton producer and consumer. This link is of crucial importance in all economies because without a marketing mechanism, the producer's surplus crops rot in the field as has recently been the case of smallholder sugarcane production in the Lake Victoria Basin. The mechanisms of cotton marketing involve collecting the product, ginning it, acting as wholesalers, and financing or providing credit. The Cotton Lint and seed Marketing Board offers producer credit facilities for the purchase of seed, insecticide and spraying pumps, although some of these are often unavailable or untimely. Although the Cotton Lint and Seed Marketing Board has authorized the Cooperative Unions to monopolize the buying of seed cotton, the marketing processes have so far been unsatisfactory to the desire of the producers. Some union officials have even deliberately delayed payment to the poor farmers desperate to the extent of selling their seed cotton to the illegal buyers at price lower than the gazetted price (Republic of Kenya, 1977). These factors combined with others have discouraged the farmers as is confirmed by a tangible drop in cotton hectarage in Busia District during 1977, although this situation is not reflected in other districts (Table 3). Streneous efforts over several years have failed to achieve the objective of a substantial increase in cotton production (Table 4) partly because the net monetary return from cotton has been relatively unfavourable compared with that of other crops (Republic of Kenya, 1972). In an effort to overcome this bottleneck, the Cotton Lint and Seed Marketing Board has since 1973 made an annual increase in prices paid to the cotton producers (Tables 3 and 4). It has been able to do this because of buoyant international demand conditions for cotton. Despite these price increments, the net monetary return to the cotton farmer is still negligible to give sufficient incentive for constant cotton production in several districts in the Lake Victoria Basin (Table 4). In view of the foregoing discussion, the contention that lack of development in an agrarian peasant-based economy is due to the intertia and essentially conservative attitude of peasant farmers, reluctance to take advantage of new economic opportunities and to change their production patterns in the region must be dismissed as false and misleading. Aldington (1971) attributed the poor performance of Kenya's cotton industry to standards of husbandry and prices offered to farmers so that the farmers do not consider the cotton as rewarding crop to grow. He further calculated the gross return per 0.4ha of cotton to be Kshs 65 in 1968 and Kshs 81 in 1969, but after deducting the cost of purchased inputs used which were probably low, he concluded that the average return to labour on this crop which is relatively labour-intensive must be very discouraging. Clean weeding is overemphasized by some farmers to the extent of making cotton

Table: 3 Cotton production in Hectarages in the Lake Victoria Basin of Kenya.

YEAR	BUNGOMA	BUSIA	KAKAMEGA	KISUMU	SIAYA	SOUTH NYANZA	PRICE IN Kshs 100Kg^{-1}
1965	2023	12141	1718	-	-	-	104
1966	3035	16188	1012	-	1053	11488	95
1967	5328	27337	2711	2308	734	12667	95
1968	4375	29095	2156	2072	2662	-	98
1969	4632	24761	2040	2405	3511	8980	97
1970	7310	35969	2654	3279	4350	14800	98
1971	4806	29535	1324	3346	5166	11412	104
1972	4300	32802	1200	3973	4103	7806	115
1973	4400	32119	845	1849	3412	5653	112
1974	4450	41674	678	2650	3411	12456	155
1975	4821	32967	1232	2249	3411	14000+	192
1976	5200	37555	771	2677	3884	14806	209
1977	5600	23081	994	5446	5486	18564	288

SOURCE: District Agricultural Annual Reports, and Economic Survey.

Table 4 Cotton Production in '000 Kilogrammes in the Lake Victoria Basin of Kenya.

YEAR	BUNGOMA	BUSIA	KAKAMEGA	KISUMU	SIAYA	SOUTH NYANZA	PRICE IN Ksh. 100Kg
1965	409	1522	-	-	1575	-	104
1966	404	2220	93	-	921	-	95
1967	556	1948	133	511	483	-	95
1968	249	1067	41	454	50+	-	98
1969	244	1497	54	541	96	592	97
1970	269	1375	48	477	265	-	98
1971	119	1093	79	68	244	466	104
1972	287	637	85	2553	302	508	115
1973	616	694	-	772	1125	457	112
1974	2373	-	-	4417	534	1043	155
1975	714	7204	-	607	453	1091	192
1976	433	7528	82	1730	392	1721	209
1977	1400	7528	-	2500	280	2735	288

SOURCE. District Agricultural Annual Reports and Economic Survey.

growing at the current prices and cost of insecticides uneconomical (Republic of Kenya, 1977). In view of this problem, farmers have compromised with nature to grow late cotton and apply no sprays hoping to harvest some cotton at a minimal profit. Alibaruho (1974) described declining cotton production as a:

> phenomenon which reflects changing economic interrelationships between various outputs on the multi-product peasant farms and these interrelationships show responses by cotton farmers to the relative price they have faced... in the light of the different production and marketing opportunities available.

Considering an average yield of about 250Kg ha^{-1} of seed cotton, Burrows (1975) calculated the gross monetary returns per hectare. Using producer prices at the rate of about Kshs 1.10 per Kg for first grade, AR (Safi) and Kshs 0.50 per Kg for second grade, BR (fifi), he found that the average gross monetary returns per hectare ranged from KShs 130 to Kshs 300 depending on cotton quality. These latter statistical figures confirm Aldington's (1971) findings because if expenditure on inputs is substracted then the farmer is definitely left with nothing. Even worse than this is the fact that the cotton yield in most districts is extremely low and varies from year to year (Table 5). Under these conditions it is possible to study cotton production by applying

Table 5: Cotton yield Figures in Kg/ha in the Lake Victoria Basin of Kenya.

YEAR	BUNGOMA	BUSIA	KAKAMEGA	KISUMU	SIAYA	SOUTH NYANZA
1965	125	-	-	-	-	-
1966	133	137	92	-	874	-
1967	104	71	49	221	658	-
1968	57	37	19	219	19	-
1969	53	60	26	225	27	66
1970	37	38	18	145	61	-
1971	25	37	60	20	47	41
1972	67	19	71	643	74	65
1973	140	30	-	418	330	81
1974	533	-	-	158	156	84
1975	148	219	-	270	133	78
1976	83	200	107	646	101	116
1977	250	326	-	459	51	117

SOURCE: Table 3 and 4.

an econometric model coined by Von Thunen which is defined by the equation:

$$R = E(p-a)\ Efk,$$

Where R = net monetary return per unit area.
k = distance (variable quantity)
E = yield per unit area
p = market price of cotton
f = transportation rate per unit distance
a = production cost per unit area

But Von Thunen made several assumptions which make the model to be too theoretical. One of the assumptions is that the marginal producer sets the market price of, say, cotton so that he still gets some profit from the crop. Alibaruho (1976) in his econometric approach explained that the pattern of cotton distribution is changing according to the ecological feasibility of growing alternative food crops, and according to the accessibility to the main urban markets for these crops. This is a deviation from Von Thunen's model which assumes that the physical environment is homogeneous, while there exists only one market centre. From the foregoing discussion it is clear that we are dealing with human materials and in selecting a crop the farmer is faced with a wide array of variables some of which cannot be expressed quantitatively. Human preference, ecological factors, economic factors, social considerations and human abilities cannot be ignored in cotton production in the Lake Victoria Basin. Cotton production seems to be unattractive relatively to competative crops such as maize, beans and sorghum (Table 6). In view of this point, most farmers are currently turning to growing sugarcane which appears to have a more lucrative market. Under free enterprise competition, it is likely that the current encroachment of sugarcane into the Cotton Belt (Fig 3) may inevitably cause a fresh downward trend in cotton production in the future unless proper plans are devised by the Government to increase producer prices, eliminate delayed payments and subsidize cotton production.

Cotton Extension Programme

Extension organizations are concerned with the problems of increasing agricultural productivity rather than the politics of distributing its benefits (Leonard, 1977). There is no indication of any significant response to extension efforts to promote cotton production in the Lake Victoria Basin. The low cotton productivity in the region (Table 5) may reflect late sowing of the cotton crop, a minimum of cultivation, and the virtual absence of effective pest and disease control. Saylor (1970) sights occasions when he found very little relationship between the extension agents' visits to the farmers and increased agricultural productivity. This hypothesis needs to be tested in the context of cotton productivity and extension programme in the Lake Victoria

Table 6: AGRICULTURAL PRODUCTION IN NYANZA AND WESTERN PROVINCES LAKE VICTORIA BASIN: 1969/70. (AREA PLANTED IN '000 HA.)

CROP ENTERPRISE:	SOUTH-NYANZA	KISUMU	SIAYA	KAKAMEGA	BUNGOMA	BUSIA
Improved Maize	1.2	0.8	4.3	41.3	21.7	2.1
Unimproved Maize	62.5	32.9	40.0	34.9	17.1	17.4
Finger Millet	2.7	0.2	0.3	2.7	5.6	6.4
Sorghum	28.4	23.6	23.6	9.5	4.5	7.8
Beans	14.3	9.1	12.4	10.8	4.6	5.0
Cow Peas	2.2	0.8	1.4	0.8	-	0.1
Yellow, Green & Black Grams	-	0.8	-	0.1	-	0.1
Cotton	12.3	0.8	3.9	0.4	3.3	10.
Sugar Cane	2.2	1.2	0.5	2.1	0.1	0.1
Groundnuts	4.0	1.2	1.1	0.9	0.5	0.3
Oil seeds	0.1	0.3	0.9	0.2	0.7	0.3
Cassava	8.3	3.2	5.5	6.3	3.3	3.3
English Potatoes	0.2	0.2	-	-	-	-
Sweet Potatoes	1.2	1.2	0.2	0.9	1.3	1.3
Cabbages	0.1	0.1	-	2.2	-	-
Bananas	0.6	0.8	0.1	7.2	2.1	2.1
Field Peas	0.4	2.3	0.8	-	-	-
Coffee	1.0	-	-	3.3	0.9	0.9
Bulrush Millet	-	-	-	0.9	-	-
Tea	-	-	-	4.2	-	-
Other Temporary Crops	-	0.1	3.4	0.3	0.2	0.2
Other Permanent Crops	0.2	0.2	0.1	-	-	-
Other fruits	0.1	-	-	0.1	0.1	0.1
Other Millet	2.8	-	-	1.8	-	0.8
Other Cereals	0.1	-	-	0.2	0.3	-
Other Vegetables	0.1	-	-	-	-	-

Source: Statistical Abstract, 1977.

Basin. So far the farmer has been reluctant to emphasize cotton as a cash crop partly because of the absence of drive in planting campaigns to interest the smallholders in maintaining present hectarage and increasing hectarage under production. In view of this problem, a campaign should be mounted by the extension officers (Bwana Shambas) as well as the Cotton Lint and Seed Marketing Board to encourage producers not only to put more land under cotton plantation but also to carry out proper agronomic practices in order to enhance cotton productivity. But even with the constraints eliminated, the farmer will still need to undergo some considerable educational process before applying effectively

the research materials at his disposal. More extension workers are required for this purpose since the present extension coverage is too sparse to permit effective work in the Lake Cotton Area. The results obtained from cotton research stations should be passed to the small-scale farmers through extension services for implementation and in return to receive the feedback information to enable the reorientation of research towards development trends and to suit small-scale farmers needs. The available technical information has perhaps not been fully utilized at the small-scale farm level to boost cotton production due to lack of extension officers in the Lake Victoria Basin. To date, lack of adequate extension officers has made the introduction of innovations in the region almost practically impossible.

Agronomic Practices

Theoretically, the Lake Cotton Area small-scale farmer has been blamed for the following agronomic practices which have contributed to low cotton productivity.

(a) Land preparation is undoubtedly a serious constraints in the extensive areas where there are insufficient oxen or where, as in the Kano plains, Karachuonyo, Kanyada, Lambwa Valley and Uyoma, all land must be ploughed and harrowed, but there are only limited periods when the soil is neither too dry rot too wet for ploughing by oxen. Poor land preparation and broadcasting the seed often lead to low yields, although it is not always necessary to plant on ridges and camber beds unless one is dealing with montmorillonite clays where water-logging and soil moisture holding capacity are a problem.

(b) Monocotyledonous and dicotyledonous weeds influence cotton yields. If weeds are allowed to grow unchecked, growth of the cotton is stunted, crop maturity is delayed and yields are depressed by 45-85% (Singh, 1970). Timely weeding, however, will increase yields considerably. During the growth of the crop, especially in the early stages, it is important to keep the ground thoroughly weeded. Unfortunately weeding occurs during the heavy rains which makes the soils, particularly, montmorillonite clays difficult to work and weed eradication by manual labour is almost impossible. In these circumstances, pre-emergence and post-emergence applications of herbicides may offer the only satisfactory method of weed control.

(c) Failure to harvest at the appropriate time is another factor leading to low cotton yields, although this is partly determined by the environmental factors, particularly unreliability of rainfall

regimes which are beyond the control of the farmer.

(d) A major problem of cotton production, however, is the failure of the farmers to improve the standard of cotton husbandry by applying fertilizers and insecticides. Much of the crop is lost through insufficient protection of the plants from pests. The adoption of suggested improvements in agronomic practices relating to time, methods of sowing, soil management, timely weeding and harvesting cannot lead to higher yields unless these are accompanied by applications of fertilisers and insecticides. There has been corresponding cotton yield response to fertilizer application in some parts of Busia and South Nyanza Districts. The problem is that farmers rarely apply fertilizers.

(e) Other miscellaneous agronomic practices reducing cotton yield in the Lake Victoria Basin are: neglecting to uproot and burn old cotton stalks; crop rotation and inter-cropping may be undesirable, but this is practised partly because of land shortage due to population pressure in the Lake Victoria Basin:

Labour Constraints

In the Lake Cotton Area, cotton is sown in the main rains. The early-sown crop has proved to be of a high yielding potential, although the achievement of this potential is determined by a reasonable standard of weeding and application of pest and disease control measures. To date, yield potential rapidly declines with later planting. With proper agronomic practices, cotton planted in May gives only half the yield from cotton planted in March or early April, at the commencement of the long rains. On small-scale farms cotton planting is often delayed until food crops are established, commonly taking place in June and July. This is associated with seasonal labour constraints and the desire of the farmer to establish an adequate area for food crops to meet the needs of his family. Small changes in food supply and demand may result in soaring prices of food crops. A more important factor has been the smallholder's preference for the growth of food crops both for subsistence needs and for the sale of any surplus. Even in those areas of the Lake Victoria Basin where it would have been more profitable for him to grow cotton and buy his food requirements, his attitude that he is not going to buy what he can grow has led to his insistence upon planting maize, sorghum, beans and cassava even though the yields may have been low. Thus, top priority is therefore given in attempting to achieve self-sufficiency in food supplies and if possible, a marketable surplus. However, there is need to design

cropping systems which may avoid labour conflicts during land preparation, planting, weeding, spraying and harvesting. Until these systems are available, it is possible that small-scale farmers will continue to shy away from growing more cotton because of its high labour requirements at the times when subsistence crops need more attention for various operations: planting and weeding. One of the Steps during the initial stages of the Lake Victoria Basin Development is to analyze patterns and labour profiles to determine input packages. Another observation is that the smallholder who prepares his cotton early often finds himself at a disadvantage of having to store his produce until the opening of the cotton markets (Anthony and Brown, 1970).

Communications

Most of the feeder and access roads in the Cotton Belt are inadequate and impassable during the rainy periods. It is said that where an area's communications are regularly disrupted in the wet periods or where transportation costs are abnormally high because of impassable roads, trade will be discouraged and the area will tend to rely on subsistence farming and contribute little to the economic development of the nation (Republic of Kenya, 1970). This is perhaps one of the reasons for the smallholders emphasis on food crops (Table 6) and poor atitude to cotton production. There is inadequate transportation facilities in the Cotton Belt of the Lake Victoria Basin. This is confirmed by the recent allegation that over 600,000 kg of cotton, worth Shs 2 million had been lying in various cooperative societies in Siaya District because the Cotton Lint and Seed Marketing Board could not provide transport to the ginneries (KNA, 1979). The board has also failed to provide adequate storage facilities, particularly gunny bags, which have hampered cotton production since with heavy rainfall at the time of harvest, the lint deteriorates fast. In the case of roads, it is surprising to find relatively excellent tea, coffee, sugar and paper roads in the Lake Victoria Basin, while there are not proper roads for cotton. This kind of situation is rather embarrassing since the small-scale farming areas which were poorly served by communication network before independence still experience the same problems. Nevertheless, the discussion on communication although interesting because of its influence on cotton production, is beyond the scope of the present paper.

Ecological Contraints

Much has already been said about the influence of ecological factors on cotton production. The rains in the Lake Victoria Basin are highly erratic in time of onset, inconsistent in distribution and often insufficient in quantity. Table 4 shows that cotton production fluctuations in the Lake Victoria Basin is quite tangible. In 1971, Siaya, South Nyanza, Busia and Bungoma experienced drought which contributed to lower cotton production. Similarly, cotton output

fluctuated in the preceding and succeeding years in several districts partly because of drought hazards. King (1957) found a highly significant positive correlation between rainfall and yield Index. But the fluctuations in cotton production in the Lake Victoria Basin cannot be explained in terms of moisture stress alone because it is evident that some districts have increased their production despite the problem of rainfall fluctuations. This departure could perhaps be partly explained by increased cotton hectarage in some areas (Table 3) and partly be attributed to management practices.

CONCLUSION AND RECOMMENDATIONS FOR POLICY IMPLICATIONS

Conclusion

Evidence emanating from the present discussion clearly indicates that the impression that the indigenous cotton farmers in the Lake Victoria Basin were resistant to innovation is false and misleading. It is quite clear that cotton was initially introduced under compulsion to facilitate an exchange economy, to satisfy the needs of the railways and to pay Government taxes. Cotton never enjoyed a lucrative market that is generally enjoyed by crops like sugarcane, tea, coffee, maize and the like until now. Thus one of the stumbling blocks in cotton production is the marketing and purchasing system. It seems to me that cotton has been influenced throughout its history by the Government's policy because during the early 1930s when locusts destroyed food crops, the cotton price was increased to encourage farmers to grow more cotton to obtain cash for buying food to alleviate famine, while during the Second World War growing food crops was encouraged at the expense of cotton. Agricultural conditions in the Lake Victoria Basin have been aggravated by a host of interacting ecological, historical, political, demographic and socio-economic forces (Blundell, 1962, Marco Survey, 1965 and Rukandema, 1977). The area is subjected to frequent hailstorm, pests, weeds, seasonal droughts and floods which may sometimes be severe enough to impair cotton production. But more serious is the spatial variation in timing and quantity of the rainfall which may mean that the farmer has less probability of obtaining a reasonable cotton yield in the region. Unlike most of the crops grown in the Lake Victoria Basin, cotton is a source of food, clothing and shelter. Future efforts in cotton production should not be frustrating since there is much scope for success, particularly as the crop has multiple uses, its domestic and world market demand greatly exceeds its production.

Recommendations for policy implications

The following recommendations for policy implications warrant intensive investigation in the short-and long-term if cotton is to be economically feasible and attractive to the producers in the Lake Victoria Basin of Kenya.

(1) Whatever the advantages or disadvantages of the present system of cotton farming, the result appears to be that cotton growers have not been so well-rewarded for their labours partly because of low prices and partly because of low yields. In view of this policy on cotton production sector is prerequisite to provide adequate prices to stimulate increased cotton production in conjuction with other policies aimed at increasing cotton productivity. Thus the author recommends an immediate action to re-examine the present Government's price policy.

(2) The Government's policy to increase prices per se without other forms of improvements such as access to market outlets, education extension services, capital facilities, good roads, improved agronomic practices, proper land use planning, and high value cotton may not necessarily lead to economic improvements of cotton and standards of living of the people.

(3) The varied yields and production obtained in the Lake Victoria Basin suggests that research on cotton growing problems in general must be intensified if the policy of increasing production and achieving self-sufficiency is to be a reality.

(4) There is urgent need to establish intensified investigation into the problem of cotton plant-soil-water relationships.

(5) There is need for more sophisticated development of resistant cotton varieties to pests, diseases and weeds. A research should be conducted on the bionomics and techniques of controlling these organisms. Ultimately, energetic research is required on pre- and post-emergence herbicide spraying in various cotton belts in association with cultural practices and to specific monocotyledonous and dicotyledonous weeds.

(6) An integrated approach to study individual, group and irrigation farming systems in the cotton Belt of the Lake Victoria Basin is required to facilitate a comparison of the conditions of these sectors of agriculture.

(7) It is possible that the development of water for irrigation purposes coupled with the application of insecticides, herbicides and fertilizers in the Lake Victoria Basin will boost cotton yield and production. Nevertheless, research is required to establish

the possible environmental risks due to application of insecticides, herbicides, fertilizers and irrigation.

(8) There is need for analysis of patterns and labour profiles to determine input packages during the initial stages of the Lake Victoria Basin Development.

(9) There is need for intensified research to control diseases (trypanosomiasis, Bilharzia, Malaria, etc.), swamps, control floods and provide better communication network in the early stages of the Lake Victoria Basin Development.

(10) There is need for cooperation between riparian countries, politicians, administrators, experts and the residents of the area.

In summary, todays research cannot feed today's hunger, but unless today's research is carried out today tomorrow's needs will not be met (Gebrewold, 1956). In the short-and long-term it is likely that it is through application of modern technology and scientific research that cotton production will be increased.

REFERENCES

1. ACLAND, J.D. (1977) East African Crops: An Introduction to the production of field and plantation crops in Kenya, Tanzania, and Uganda. Longman.

2. ALIBARUHO, G. (1974) "Regional Supply Elasticities in Uganda's Cotton Industry and the declining level of cotton output", in the Eastern African Economic Review.

3. ALIBARUHO, G. (1976) The Dynamics of Location: A Von Thunen - Supply Analysis of the changing Spatial Characteristics of Cotton in Uganda. East African Geographical Review, No. 14.

4. ALDINGTON, T.J. (1971) "Producer Incentive as a means of promoting Agricultural Development: A Case Study of Cotton in Kenya", in Institute for Development Studies, Discussion Paper 105

5. ANTHONY, K.R.M. and BROWN, K.J. (1970) Cotton Development in Kenya. Cotton Research Corporation.

6. BAUSTAD, B.M. (1974) Cotton Seed Meal in the Feeding of Growing Pigs. East African Agricultural and Forestry Journal, Vol. 40, No. 1

7. BERGER, J. (1969) The World's Major Fibre Crops: Their Cultivation and Manuring. Centre D'etude De L'azote, Zurich.

8. BLUNDELL, M. (1962) African Land Development in Kenya Ministry of Agriculture, Animal Husbandry and Water Resources, Nairobi, Kenya.

9. BRADLEY, T. (1968) Kenya: Nyanza and Western Provinces (Lake Cotton Area). Progress Report for the Season 1965-66

10. BRETT, E.A. (1973) Colonialism and Underdevelopment in East Africa. The Politics of Economic Change 1919-1939. Heinemann.

11. BROWN, K.J. et al. (1972) Cotton Growing Recommendations for Kenya. Agricultural Information Centre, Nairobi, Kenya.

12. BURROWS, J. (1975) Kenya: Into the Second Decade. Report of a Mission sent to Kenya by the World Bank, Part III. Johns Hopkins University Press.

13. CHISHOLM, M. (1968) Rural Settlement and Land Use: An Essay in Location. Hutchinson University Library.

14. CONE, L.W. and LIPSCOMB, J.F. (1972) The History of Kenya Agriculture. University Press of Africa.

15. De WILDE, J.C. (1967) Experience with Agricultural Development. The Case Studies, Vol. II. Johns Hopkins Press.

16. FEARN, H. (1956) Cotton Production in the Nyanza Province of Kenya Colony, 1908-1954. Empire Cotton Growing Review, Vol. 33, No. 2

17. FEARN, H. (1961) An African Economy: A Study of the Economic Development of the Nyanza Province of Kenya, 1903-1953. Oxford University

18. GEBREWOLD, M. (1956) Attitude of the African Farmer to Modern Agricultural Methods. Empire Cotton Growing Review Vol. 33, No. 2

19. GIBB, A and PARTNERS, (1965) Kenya Nile Basin Water Resources Survey 1954-6. Matcalfe and Cooper, Ltd.

20. HAY, M.J. (1972) Economic Change in Luoland: Kowe, 1890-1945. Ph.D. Thesis. University of Wisconsin.

21. HOUNAM, C.E. et al (1975) Drought and Agriculture. Technical Note No. 138. WMO-NO. 392

22. JAMESON, J.D. (1970) Agriculture in Uganda. Oxford University Press.

23. KENNEDY, T.J. (1964) A Study of Economic Motivation Involved in Peasant Cultivation of Cotton. East African Institute of Social Research Conference, University of East Africa, Makerere College, Kampala, Uganda.

24. KING, H.E. (1957) Cotton yields and weather in Northern Nigeria. Empire Cotton Growing Review, 34.

25. KIPPS, M.S. (1970) Production of Field Crops. A Textbook of Agronomy. McGraw-Hill.

26. KNA (1979) Cotton Board is rapped. Standard, Monday, July 2, 1979

27. LEONARD, D.K. (1977) Reaching the Peasant Farner: Organization Theory and Practice in Kenya. University of Chicago Press.

28. MARCO SURVEYS (1965) A Baseline Survey of Factors Affecting Agricultural Development in three Areas of Kenya. Marco Survey, Ltd.

29. MUTURI, S.N. (1976) Constraints in Cotton Production. Kenya Agricultural Research System. Scientific Research Division Paper 2. Ministry of Agriculture. (Unpublished).

30. NGUGI, B.D., et al (1978) East African Agriculture. A Textbook for Secondary Schools. MacMillan Education Ltd.

31. OBARA, D.A. (1973) The Impact of the Tsetse-flies in the Lambwe Valley, South Nyanza: A Geographical Viewpoint. B.Sc. Dissertation, Department of Geography, University of Nairobi.

32. OBARA, D.A. (1976) Environmental Problems of Smallholder Sugarcane. Production in the Nyanza Sugar Belt. M.Sc. Thesis, University of Nairobi.

33. OMINDE, S.H. (1968) Land and Population Movements in Kenya. Heinemann, London.

34. PRENTICE, A.M. (1972) Cotton: with special reference to Africa. Longman, London.

35a. PURSEGLOVE, J.W. (1974) Tropical Crops: Dicotyledons. Longman, London.

35b. REPUBLIC OF KENYA (1970) Development Plan for the Period 1970-1974. Government Printer, Nairobi.

36. REPUBLIC OF KENYA (1970) Nyanza and Western Provinces: Regional Physical Development Plans. Town Planning Department, Ministry of Lands and Settlement.

37. REPUBLIC OF KENYA (1972) Economic Survey. Central Bureau of Statistics, Ministry of Finance and Planning.

38. REPUBLIC OF KENYA (1974) Development Plan for the Period 1974 to 1978. Part 1. Government Printer, Nairobi.

39. REPUBLIC OF KENYA (1977) Busia District Annual Report, Ministry of Agriculture.

40. REPUBLIC OF KENYA (1979) Development Plan 1979-1983 Part II. Government Printer, Nairobi.

41. RUKANDEMA, F.M. (1977) Resource Availability, Utilization and Productivity on Small-Scale Farms in Kakamega District, Western Kenya. Ph.D. Thesis. Cornell University.

42. SAYLOR, R.G. (1970) Variations in Sukumalan Cotton Yields and the Extension Service. Paper No. 70.5 Economic Research Bureau, University College Dar es Salaam.

43. SINGH, C. (1970) Cotton Growing Problems in Madhya Pradesh, India, and Measures to tackle them. Cotton Growing Review Vol. 47.

44. SWYNNERTON, R.J.M. (1955) A Plan to Intensify the Development of African Agriculture in Kenya. Government Printer, Nairobi.

45. Van ZWANENBERG, R.M.A. and KING, A. (1975) An Economic History of Kenya and Uganda 1800-1970. East African Literature Bureau.

46. VAVILOV, N.I. (1951) The Origin, Variation, Immunity and Breeding of Cultivated Plants: Selected Writings. Ronald Press.

47. WOODHEAD, T. (1968) Studies of potential evaporation in Kenya. Ministry of Water Resources and Development.

FIG. 1 COTTON GROWING AREAS IN KENYA

The second Tanzania project involves abstration of the Lake Victoria to be transferred to central Tanzania for purposes of irrigation. There is vast land area in central Tanzania where productivity is restrained by drought. Therefore, transfer of water from the Lake by pumping or gravity supply would enhance agricultural productivity. The precise details of the project are not available, nor is the precise acreage to be irrigated known. It is, nevertheless, important to know that the project is irrigation, which is a heavy water consumer and which would perhaps change the hydrological regime of Lake Victoria significantly.

Ironically, while for Kenya a level of the Lake higher than the 1960 level, for example, has posed problems, as will be discussed below, for Tanzania a higher level of the lake might result in lower pumping costs and larger areas of irrigation. Therefore, in fact, Tanzania might at one point be found in agreement with Egypt which encourages the storage value of Lake Victoria, as noticed in an analysis of the Owen Falls Dam Agreement. Yet at other points, Egypt might disagree with the Tanzania project for consuming too much water. For Kenya, the Tanzanian project may be appropriate, if the rising level of the lake continues to be the nuisance it has been since 1961. However, Kenya might view the project with reservation if Kenya also intends to expand irrigation using the Lake Victoria waters. So there are several "if"s which would only be resolved in a negotiating context and after the countries concerned have determine the development plans intended to use the Lake Waters and how much water they intend to abstract from the Lake.

One further argument that might arise regards trans-basin transfer. Other Lake Victoria basin and Nile basin states not intending similar uses of the basin waters might argue that the water of the basin should be used only in the basin unless enough is available for all uses. On this, there is no clear-cut rule of international law, and we doubt that the argument would exclude the Tanzania project, if it was finally drawn up. Rather, the basic considerations is equitable tutilization, including the country's contribution to the basin water pool; the status of development; alternate water resources available; among others, would be appraised as against the same factors for the opposing states. It was noted above, for instance that Egypt has in fact transferred Nile waters for irrigation of the Sinai peninsula. Such trans-basin transfers could be considered in the broad context including other uses within the basin.

5. Kenya: There have been three categories of events related to Lake Victoria waters. There is (a) the rising level of the lake, which has been mentioned above; (b) the creation of the Lake Victoria Basin Development as a basin project; and, (c) a mooted possibility of irrigation of arid areas of Kenya using Lake Victoria waters. Each is discussed briefly below.

(a) The issue in the first instance is that although the level of Lake Victoria is known for several monthly and annual fluctuations a special trend started in 1961 and culminated in 1964 with a maximum rise of two-and a half meters. This is an unusual and unprecedented rise,[84] and the consequences in Kenya have been easily noticed. First, there is loss of large tracts of land around the lake, covered under water. Most of that land had been used for several small-scale agricultural activities, largely for horticultural products. Secondly, the breeding grounds of some of the fish species went under water and the resulting change in the ecology is viewed as possible contributor to the disappearance of some of the fish species especially the tilapia esculenta and protopterus.[85] Thirdly, the increased flooding and swamps around the Lake have provided breeding grounds for mosquitoes, thereby creating a special health problem. Finally the raised level of the lake resulted in submergence of pier facilities at Kisumu, Kendu Bay, Homa Bay and Asembo Bay. Throughout 1960's temporary pierage facilities had to be deployed at each of the above centres till the piers were rehabilitated in 1974 at a cost to the East African Railways Corporation. We are not aware of the kinds of consequences that were realized in Tanzania.

It does not seem as if Kenya ever sought to ascertain the reasons for the increased volume of water or the raised level of the lake. But the Railways authorities at Kisumu continued to receive data on the level of the lake, first, from the Uganda Ministry of Water Development, and after 1967, from the Hydrometeorological Survey headquarters at Entebbe.

---

84. See Volume I Part II of Hydromet Reports supra not 8 pp. 744-753 especially graph on p. 752.

85. Welcome, "The Effects of Rapidly Changing Water Level in Lake Victoria Upon Commercial Catches of Tilapis (pisces: Cichlidae) in Obeng, (Ed.) Man-Made Lakes: The Accra Symposium (Accra: Ghana University Press 1969) pp. 242-249; Kongere. P.C., "Production and Socio-Economic Aspects of Lake Victoria Fisheries Seminar Series on Lake Victoria, No. 6, University of Nairobi, IDS, April 1979; and Odero, N. "Fish Species, Distribution and Abundance in Lake Victoria." Seminar Series on Lake Victoria, No. 11, University of Nairobi, IDS May 1979.

But on June 22, 1973, Orinda Sibuor, a Kenyan member of East African Legislative Assembly raised the issue at the Assembly and squarely blamed the control of the outlet at Owen Falls Dam for withholding too much water in the lake and causing the high level of the lake.[86] The Ugandan delegates denied that there was any causal relations between the Owen Falls Dam outlet controls and the rising level of the lake. But at a resumed debate on the issue on the 25th June 1973 Joseph Nyerere of Tanzania joined Orinda Sibuor in blaming the Owen Falls for the problems. The Ugandan representative maintained that the level of the lake had resulted from the heavy rainfall of 1961. At the end of the day a resolution was adopted calling on the three governments to ascertain the cause of the problems and to find speedy solutions. Nothing has been done on that.

The problem of lake level can be attributable to the control of sluices at Owen Falls Dam because it started in 1961, the same year that Owen Falls Dam started operation. This line or argument rejects the "rainfall hypothesis on the grounds that the increase was too high for what might result from the rainfall, and that it lasted until nearly 1969 before a slight decline was noticed. But what might be further interesting is if the volume of water contained in the $2\frac{1}{2}$ meters increase can be estimated. For instance, if the rise of $2\frac{1}{2}$ meters accounted for about 175 billion cubic meters, then that would be equivalent to about twenty times the total annual inflow into the lake by all the Kenyan rivers together. Hydrologists and meteorologists should calculate if, with a natural out flow at Jinja, the rainfall could still have forced the lake to store that much water.

The suspicion that the control of outflow at Jinja are responsible for the increased lake level are enhanced by the fact that Egyptians negotiating the construction of the dam had (i) stressed the storage value of the dam and Lake Victoria (ii) included provisions to that effect, including a rise in the level of the lake in the agreement; and (iii) included provisions for compensation to injured parties in the agreement.[88] Therefore, any quick submission that the dam could not have caused the rise in the level of the lake is found suspect.

---

86. See The East African Standard (Nairobi) June 23, 1973 p.5.
87. ibid. June 26, 1973 p. 4.
88. See supra, pages 33-36

As noted earlier, the Hydrometeorological Survey of the Lake basin of Eastern Africa maintained that the sum of the outflow through the turbines and through the sluices equalled the natural regime of the outflow at Jinja and that the dam was not responsible for the increased level.[89] Unfortunately, the hydro-meteorologists did not give their theory as to the cause.

Meanwhile, a Kenyan cabinet minister recently submitted before Parliament that no experts had given him a satisfactory explanation as to the cause of the raised level of the lake. He added, "I believe that the /Jinja/ dam causes the water to rise and consequently lakeshore residents are often subjected to floods".[90]

It seems that the last word on the problem has not been said, and no dogmatic views should be accepted. The Hydrometeorological Survey team could have given a more complete answer to the question. However, should Kenya and Tanzania not find the information from the unit sufficiently neutral then they should seek an agreement on a balanced formula for assessing the cause(s) of unusual rise in the Lake Victoria level. Some general observers report that the level has been on the upswing since the beginning of 1978 and that the change is already noticeable at popular spots such as Hippo Point at Kisumu. The Ministry of Water Development is understood to be conducting studies to verify this state of affairs and they may have some explanation or better hypotheses in the next month or two.

(b) The establishment of the Lake Victoria Basin Development Authority to spearhead comprehensive development in the catchment area of Lake Victoria is a unique development. Through the working programmes of the Authority Kenya might soon begin to realize aspects in which it needs to consult with the other two riparian states.

Some of the question may be hydrological. For instance, programme planning might be trecherous unless problems such as erratic rise in the level of the lake are eliminated. On the other hand, increased use of the waters of the rivers before they reach the lake may have effect on the level of the lake. By the same token, if such utilization of water can make a difference for the lake level, then it might also have impact on the water flowing down the Nile. In which case, Egypt might want to discuss

---

89. See discussions referenced not 8 above.

90. Hon. James Osogo, Minister of Health in parliamentary debate, reported in The Standard (Nairobi) July 8, 1976.

with Kenya the seasonality and quantity of water used on tne Kenya side. This might be particularly the case if Tanzania also decides to carry out their irrigation project, because the combined impact of the use by the major source of Lake Victoria waters might make a major difference in the water storage which Egypt has always coveted.

There is also the question of conservation of fishery resources of the lake. Although the popular view is that there has been very little migration of fish in and out of Winam Gulf, conservation measures to maintain the proper resource balance might still be necessary. Absence of large scale migratory patterns by the lake fish species does not mean that fish obey the territorial boundaries because by nature, fish move the hydrosphere according to their respective biology. After all, the Nile perch is supposed to have wandered from the Nile into Lake Victoria up to Winam Gulf on their own volition.[90a] Therefore, a modicum of consultative framework among the three littoral states might be necessary if the Authority is to have effective long-term control of fish as an important development resource.

(c) It has been mooted in Kenya that, given adequate technology, Kenya should transfer the Lake Victoria catchment water to the arid areas of the c country for purposes of irrigation.[91] Perhaps the handiest scene for that kind of experiment would be the Kerio Valley for which a special development Authority has been established by parliament. The question of feasibility of such projects is an engineering one which some observers say is within reach.

Such undertakings would use massive quantities of water if it was to be executed at all. In a large measure, the projects would be analogous to that of Tanzanian irrigation of its central lands. And perhaps for engineering reasons the two governments alone would need to consult with one another so that they can establish the amount taken which, in turn, would determine the lake level and therefore given indication of the power needed to transfer water from the lake to the fields.

Once more, such projects would make Egypt very nervous since they have, since Owen Falls Agreement stationed resident engineers at Jinja just to oversee the water storage value of the lake. Needless to say, it

---

90a. Kongere, P.C. "Production and Socio-Economic Aspects of Fisheries in the Lake Victoria Basin" (Kenya) Seminar Series on Lake Victoria Basin Development No.6 (Institute for Development Studies, University of Nairobi, May 1979) pp. 10-11.

91. Daily Nation (Nairobi) March 17, 1978 p. 3.

would be up to Egypt to change its attitude to date, and urge for an agreement on hydrological and legal regime of the Lake Victoria and Nile basins.

6. General: There are some general developments in the international scene which would have impact on the use of the internationally shared water resources.

First, there are changes in the general political economy. No group of states demonstrated it better than Arabs that a national natural resource is a powerful political weapon when Arab states imposed oil embargo against friends of Israel. Thus, informal commentators have argued that water should be used to bargain with Arab states for their oil. So the slogan would go "one barrel of oil for a barrel of water flowing down the Nile past Nimule!" The seeming joke makes the point even though Egypt may have had its problems with some of the oil producing Arab states.

The foregoing point relates to the question of the New International Economic Order whereby states are supposed to cooperate in the management of resources to promote equitable development.[92] The accent here is on cooperation to prevent both waste of resources as well as conflicts arising from absence of cooperative framework for management.

Secondly, the range of demands on the water resources is increasing and one of the most serious ones is the problems of pollution. As noted earlier on, conservation of the resources of the Lake Victoria must be approached on a lake-wide basis because pollution will not respect the territorial boundaries. Municipal and industrial effluents discharged into one part of the lake in one of the three countries will have consequences other state. Thus, V M. Eyakuze of the then East African Medical Research Institute, and his colleagues, called on the East African states to form a regional commission on water pollution to find mechanisms for preventing continued pollution on Lake Victoria.[93] They observed that the Lake pollution was becoming "increasingly evident in the past few years" to the extent that it threatened some fish species. Similar alarm had been sounded by Kenyan authorities.[94]

---

92. See comments referenced supra note 39.

93. Daily Nation (Nairobi) February 7, 1973.

94. East African Standard (Nairobi) Dec. 12, 1971 p. 7. See some recent concerns expressed in Daily Nation April 12, 1979 p. 5.

What is important in these pollution-related developments is not the alarmist content but that they are pointers to an impending problem which requires early preventive action.

Thirdly, as analysed in Section III above, the applicable law on internationally shared water resources has been developing and is certainly more crystallized today than in 1960 when the last agreement on the Nile waters was signed. Therefore, it might be worthwhile for all the basin states to have a fresh look at the legal regime and to begin working together on formulation of a regional practice meeting local exigencies.

VI FINAL COMMENTS

For every issue discussed here conclusions have been drawn at the end of every section. What seems clear throughout is the desirability for a framework for consultation and exchange of information on actual or intended projects involving utilisation of the basis waters. One responsibility to be accomplished within the framework might be actual hydrological and meteorological studies to ascertain basic or secondary facts and consequences of the use of such waters.

What the countries decide to call the "framework" is immaterial so long as it involves all the basin states and embraces the kinds of issue areas that have been apparent in the above analysis. That is, the present system where Egypt decided to cooperate with Britain as a colonial power and to ignore a country as key to her interests,as Ethiopia which provides about 85 per cent of water passing through Khartoum, should be considered untenable. But the disarray noticeable in the present treaty situation should not be allowed to continue in view of the recent developments we have seen above.

Kenya, Tanzania and Uganda ought to remember that pursuant to the 1959 Agreement, Sudan and Egypt have undertaken to adopt a joint position in event of any negotiations with third states. It is also important that the two countries are better equipped in terms of hydrological and meteorological data because they have worked at it since the 1950 agreement. They are also favoured in terms of access to, and basic facts behind, the present hydrometeorological survey done under auspices of World Meteorological Organization. There is very little

advantage for the three East African countries in terms of technical information as compared to Egypt and Sudan. But they can surely use bargaining skills given the present state of the art in law of internationally shared water resources. The question is not one of re-negotiation of the legal regime but one of "clean-slate" negotiation because for most of the states there is no previously negotiated agreement on this subject area. It is easier to agree on such a framework while there is a propitious atmosphere than after a conflict has arisen among all or some of the basin states.

MINERAL RESOURCES OF THE LAKE VICTORIA BASIN

By

Isaac O. Nyambok
and
Colins Y. O. Owayo
Department of Geology
University of Nairobi

INTRODUCTION

The idea of regional development strategy brings into focus integrated planning, covering all the available resources in an area. In many cases such strategies help to crystallise out the obvious but often forgotten interrelationship in the utilisation of natural resources. The establishment of the Lake Victoria Basin Development Authority gives a challenge as to how the resources in the area can be integrally developed, utilised and managed.

Often in our venture to exploit mineral resources, mining companies tend to localise their interests to known mineral deposits. There is also a tendency to concentrate on deposits which appear from the onset to be profitable. This leads to a neglect of the development of the by-products and also polarizes exploration to only within the limited area.

In cases where there are isolated small mineral deposits with poor infrastructre, mining companies are faced with the inevitable consideration of whether or not capital investment will be justified by the returns. Thus in order for a company to accept the heavy burden of initial capital investment, the estimated reserve of the mineral deposit must be sufficiently and profitably large. In such situations small but otherwise viable mineral deposits will not attract the mining companies. Here is where a development authority becomes very relevant, since such small deposits will be a part of an integrated development strategy.

This paper therefore sets out to discuss the mineral resources of the Lake Victoria Basin area and to propose their development, utilisation and management within the context of the Lake Victoria Basin Development Authority.

SUMMARY OF THE GEOLOGY

The geology of the Lake Victoria Basin area is shown in Fig. 1. It falls into three major groups, namely Precambrian rocks, Tertiary sediments and lavas, and Quaternary volcanics and sediments.

a) Precambrian Rocks

The major formations of the Precambrian age are the Nyanzian system, Kavirondian system, Mozambique belt and Bukoban system. The Mozambique belt often referred to as the Basement system in Kenya was for a long time considered to be the oldest formation in the area. This has now been found to have been in error (Sanders, 1965) and the sequence given above represents from the oldest to the youngest of the Precambrian formations.

Outcrops of the Nyanzian rocks occur in much of the Nyanzian Province (Fig. 1). These rocks represent the oldest formation in the Lake Victoria Basin area. They consist of metamorphosed and sheared volcanic rocks, mainly of original basaltic and rhyolitic compositions with banded iron stones: greywackes; andesitic tuffs and conglomerates. They have undergone low to medium grade of metamorphism.

Lying unconformally above the Nyanzian system and the second oldest formation is the Kavirondian system. This formation is found mostly in Kakamega and South Nyanza Districts and is composed of conglomerates, agglomerates, grits, slates and volcanics. These rocks though unrelieved are strongly folded.

Following the Kavirondian system is the Mozambique belt. It is composed mainly of gneisses and schists of sedimentary origin. These are usually accompanied by crystalline limestones, quartzites and localised magmatites. It is observed that the grade of metamorphism increases eastwards and is higher than that of the Nyanzian system. These rocks occupy Cherangani-Turbo, Nyando and Masai Mara areas. They are thrown into folds which are overturned westwards.

The youngest rocks of the Precambrian age are represented in the Lake Victoria Basin area by the Kisii series which is a part of the Bukoban system. These are composed of basalts, quartzites, felsites,

dacites, andesites rhyolites and tuffs. These rocks cover most of the Kisii highlands and extend to Kericho District, Sotik area. The series is highly faulted, with dolerites being emplaced along the faults. It is generally tilted eastwards.

b) Intrusives

A number of intrusive bodies occur within the Lake Victoria Basin area. They date variably from post-Nyanzian to pre-Bukoban and vary considerably in size and texture. These intrusive bodies are dominated by granites, but there are also dolerite, granodiorite and syenodiorite intrusives. The bulk of the intrusives occur as the Bukusu batholith and Maragoli granite. Other significant occurrences of the intrusives are found close to Kenya-Tanzania border.

c) Tertiary Lavas and Sediments

The eastern part of the Lake Victoria Basin area, Mount Elgon area and isolated areas around the Winam gulf are covered by Tertiary lavas. These lavas have formed as a result of tectonomagmatic activities connected with the Rift system. They vary considerably. In the eastern part the lavas are composed mainly of phonolites nephelinites and pyroclastics. There are also limited beds of limestone and waterlain tuffs around Songhor and Koru.

In the northern part of the Lake Victoria Basin area there are occurrences of the Mount Elgon series and Bugishu series. Phonolites are also exposed in isolated places. The Mount Elgon Series is composed mainly of agglomerates and breccias of nephelinitic composition. Occurrences of tuffaceous bands have also been recorded (Gibson 1954). At the base of the Elgon Volcanic series is the Bugishu series composed of impure limestones, calcareous sandstones and conglomerates. The Bugishu series is derived from both metamorphic rocks of Precambrian age and volcanic rocks of later ages.

Close to the shores of the Winam gulf, the Tertiary rocks consist of nephelinitic lavas and agglomerates of various age with sediments of lower miocene age and of lacustrine origin, and also intrusive bodies of ijolites, uncompahgrite, nepheline syenites and carbonatites. In the southern part of the Winam gulf most of the Tertiary rocks are associated with the carbonatite centres at Homa, Ruri, Bangwe (often referred to in literature as Rangwa) and Sokolo. There is extreme complexity of the Tertiary formations within the areas of the carbonatite centres.

5) Quaternary Sediments and Volcanics

Quaternary formations cover mostly areas where due to a fall in the lake level, Pleistocene sediments are exposed. These were following by later detritus deposition. They commonly have a succession of diatomite lake beds followed by black-cotton soil. In a few areas the black-cotton soil is lacking and instead there is a thick red soil cover.

ECONOMIC GEOLOGY.

The main purpose of this paper is to present our present knowledge of the mineral resources of the Lake Victoria Basin area. This of course does not preclude further significant discoveries of mineral deposits. This section will deal with the mineral resources under the following subheadings; metallic ores, industrial mineral (non-metallics), fossil fuels and potential mineral resources. Localities of the more significant minerals in the Lake Victoria Basin area are shown in Fig. 2.

a) Metallic Ores

Gold. Gold has been and still is the most important metallic ore mineral in the Lake Victoria Basin area. It is to some extent ubiquitous within the Precambrian rocks of the Easin area. The best known occurrence of gold is at Macalder mine. The Macalder mine has in the past produced up to, 3,000 oz. per year. In 1968 alone 32,000 oz of gold were recovered. This mine has since been abandoned supposedly for reaching the cut-off level.

The earlier estimated ore reserve is about 600,000 tons with a gold content of 2.50 dwts/ton, thus giving 75,000 oz (troy) of gold in the reserve. Most of the gold based on that earlier estimate has already been mined. By 1950, 43,000 oz of the gold has already been recovered. However, this earlier estimate of the reserve may not unquestionaly reflect the real ore reserve. A reassessment of the reserve using more modern techniques would verify the reliability and accuracy of this earlier estimate.

To the south east of Macalder is the Lolgorien gold quartz veins. These have been in the last few years re-investigated, but the results have not been available to the writers. Alluvial gold was found in stream beds of the Kano Plains in 1940's. This led to exploration of the mineral around Kibigori, as a result of which a number of gold (auriferous) veins in the Nyanzian system were discovered north of Kibigori township. There have been a number of syndicates in the 1950's mining gold in this area. By the mid-1950's a total of about 16,000 oz had been recovered. Other insignificant gold

occurrences have been recorded near Koru and Songhor. The geological setting of the known gold lodes indicate that promising areas for further exploration are along shear zones.

In the Nandi area, quartz veins containing gold have been reported from the top of the scarp north of Koyo (Jennings, 1964). Panning of the streams north-west of Kaptumo has revealed the presence of gold in the water channels.

Several claims have been pegged in Maragoli area for the purpose of extracting gold. Most of these claims have since been abandoned. However they are good indications as to the gold distribution in the Maragoli area. The best known sites are in the Edzawa Valley, west-south-west of Shabahali and at Magui. Edzawa valley at one time produced about 1,067 oz per year. In the two areas most of the gold occur in dark grey quartz veins, extensively mineralised by iron sulphide (pyrite). A few prospectors have also worked alluvial gold in the Maragoli area, concentrating along the River Edzawa between Kakamega-Kisumu and Kima-Kisa roads. Some sections proved to contain very good concentrates of the mineral.

West of Kisumu gold veins have been mined in Korwenje area of Seme-Asembo. Bellamira, Ngiga and Lamac in Sakwa; Fabal, Jambo and Shenzi in the close proximity of Abom intrusive body in Asembo; and Gangu in Asembo-Sakwa. These gold deposits occur in quartz veins connected with the intrusive bodies.

North of the preceding area is the Marama gold deposits which apparently is adjoining with the Maragoli gold fields. The known areas of past mining operations are Bukura, Shigula and close to the confluence of R. Lihira and R. Yala. In the late 1930's and early 1940's the Marama gold field yielded up to about 4,000 oz per year (Pulfrey, 1945). The area is dominated by quartz vein gold, however alluvial gold has been worked in some places along the River Yala and some other smaller rivers like Likenda, Shironga and Lashironga.

Further north of the Maragoli-Marama is the Kakamega gold field. This is the most important gold field north of the Winam Gulf. It is only comparable to the Macalder gold reefs in South Nyanza. The Kakamega gold deposits overlap with the Maragoli-Marama deposits and in some cases the production statistics for the Kakamega fields include those for Marama and Maragoli areas. Up to 1950 the annual production averaged about 21,800 oz. The total reserve here is not well known due to the dispersed occurrences of the gold veins, but which can be found in the whole of Kakamega District.

Almost all the gold occurrence in the Kakamega District are associated with the Bukusu batholithic bodies.

In summary it is suggested that most of the gold deposits occur within the Nyanzian and Kavirondian systems close to the granite intrusions which gave rise to the formation of quartz veins. For further gold exploration the most promising areas, based on the geology of the known gold occurrences in the Lake Victoria Basin, are greenstone belts in the vicinity of granite intrusions.

Iron. Iron ores are found in limited occurrences in many places within the Lake Victoria Basin area. Very little attention has been given to these deposits. They mostly occur as banded ironstones apparently transformed by weathering processes. South of Winam gulf, deposits are known to occur south of Kisii town, near Oyugis, near Kendu Bay and at Bala. Bala deposits are the most important in the area. These have been estimated to contain 80,000 tons of iron ore with an Fe content of 50-60 per cent.

North of the Winam gulf, iron ore (titaniferous magnetite) deposits occur in the Uyoma and Ndere peninsulas, and pyritic lode at Bukura which is estimated at 17,000,000 tons with Fe content of 30% and sulfur 35%. More iron deposits are found close to Kenya-Uganda border (Fig. 2), Near Kibuswa on the western side of Moiben river, iron mineralization has been reported (Sanders, 1963). Iron oxides near Kibuswa are found impregnated and veined within sheared and lineated quartzites. The iron oxides contain high proportion of manganese i.e. upto 21.04 per cent.

Copper. Traces of copper have been found in many localities within the Lake Victoria Basin area, however only two places i.e. Macalder and Kitale are known to contain copper deposits of any significance. An extensive copper deposit has been known at Macalder mine for some years. The body containing 1.3% copper was estimated at 600,000 tons. Geochemical anomalies indicate that there is a large area of potential copper mineralisation. There is a great chance of mining copper at Macalder, since only small condentrate were produced before it was declared exhausted. At Kitale north-east of Macalder mine, copper occurrences are known in the area around a granite mass. Upto 5.87 per cent copper has been assayed in samples from vein outcrops. However the mineralisation is rather sporadic.

Radioactive minerals. Apart from Buru hill in Kibigori area, all the known radioactive mineral centres are associated with carbonatite occurrences such as Homa, Ruri, Sokoli and Rangwe. At Buru hill, the outcrop resembles banded ironstones of the Nyanzian system and no carbonatite bodies have been reported. Here the radioactive elements are in the amounts of REE. 2.9% Th 0.10% and CB 0.50%. In the carbonatite centres, the average content of radioactive elements are found to be REE + Th 0.06% and Nb 0.10. Localised vast quantities of a columbian mineral (perovskite) containing approximately 0.50 per cent Nb_2O_5 are present at Rangwe.

The radioactive mineral occurrences need further investigations, especially after the airborne geophysical survey carried out recently by the Canadians for the Kenya Government. Any further investigations should include exploratory drilling.

Tungsten. Tungsten in the form of its ore mineral, scheelite ($CaWO_4$) is found mostly as an accessory mineral in the goldfields of Kakamega and Kibigori areas. Samples taken from a locality south-east of Koyo beacon was assayed and found to contain 5.5 per cent WO_3. An assessment of the tungsten ores could be taken in conjunction with the gold extraction.

Tin. Specimens taken from the Little Nzoia valley have been found to contain small grains of tinstone (cassiterites). Subsequent assaying at the Mines and Geological Department showed that such specimens contain tin oxide (SnO_2) of varying amount between 0.46 - 2.57. The results show that there are disseminated tinstone within or near the margins of granodiorites (granite group). So far the results do not warrant independent prospecting for tin, but could be carried out in the context of the Lake Victoria Basin Development Authority along with the prospecting for other minerals.

Base Metals at Macalder Mine. In addition to the two major metals (gold and copper) found at Macalder mine, there are also occurrence of silver, arsenic, iron sulphide (pyrite), zinc and cobalt. These occur in association, and together with the gold-copper deposits. Silver for example has been mined together with gold in the past. This has also been the case at the Kakamega goldfields. In the 1950's comparatively higher quantity of silver than that of gold (c.p. 3,000 oz of gold and 4,100 oz of silver per year) was recovered from the Macalder mine. In the originally estimated ore reserve of 600,000 tons, the content of the base metals have been essayed as follows copper 1.3%, lead 0.8%, Arsenic 0.52%, antimony 0.03%, zinc 4.5%, manganese 0.18%, cobalt 0.20% and iron (occurring as FeS_2) 32.2%. In some cases, the zinc ore mineral

makes upto 30% of the ore deposits. On the other hand, arsenic ore mineral (arsenopyrite) which is quite limited in content has often presented problems in the extraction of gold, as a result of which arsenic has had to be separated with special techniques. To avoid unnecessary wastage and expenditure in the separation of arsenic, the mineral (arsenopyrite, FeAs S) can be used for the production of arsenic oxide.

b) Non-metallics

Kisii soapstone. There are several scattered occurrences of soapstone in Kisii District, but mainly near Samita hills. The soapstone is of varying quality. It is found within the Kisii series as an alteration product. The rock is composed of several minerals, notably sericite, kaolin, epidote, chlorite and quartz. The stone has been quarried on a small scale for many years and used for making carvings. Other possible uses after further treatment are as glass orifices and low voltage insulators.

Limestone. Limestone occurrences are widely distributed in the Lake Victoria Basin area. A few limestone like those at Koru and Bala near Homa Mountain have been worked for the production of lime. On the other hand, limestone occurrences like those of Tyoma peninsula, Businga Island, Mfangano Island and Keben have not even been well assessed. The worked deposits at Koru-Songhor area are estimated at 15,000,000 tons. In the same area, marl which is a necessary component of limestone in cement production is also available.

Apart from limestone, another carbonate occurring in the Basin area is carbonatite. The carbonatites apart from their associated radio-active minerals can also be treated to fulfil the same role as limestone. The problem with the carbonatites is their phosphorus content which is somewhat too high (5.2%) to be acceptable, for instance, in cement production.

Building Stones and Brick-Clays. Building stones and brick-clays are wide-spread in the Basin area and are being adequately exploited. Thus there is no justification to discuss them further here.

Graphite. Rocks containing graphite are known in the Mozambique belt (Basement system). Graphite occurrences have been reported from the southern slopes of Cherangari hills within the Basement rocks, the quantity of which has not yet been assessed. Recent core drilling in Bondo-Luanda area which was a follow-up of the airborne geophysical survey carried out by the Canadians, revealed a graphite body stretching from Uranga to Luanda within

the Nyanzian system. The graphite body is 10 feet wide, but at the moment the third dimension of the body is not known, therefore the quantity of the reserve cannot as yet be estimated.

Pozzolana. Pozzolana is known to occur near Lumbwa, the quantity of which is yet to be assessed.

c) Fossil Fuels.

In discussing fossil fuels, two energy resources come to mind i.e. petroleum and coal. Coal is formed as a result of fossilisation of vegetation, while crude oil is formed by decomposition of minute marine organisms. These fuels are commonly found in sedimentary environments.

It is thought unlikely that these fuels would be found in the Lake Victoria Basin area, because firstly there are no known suitable sedimentary formations in the area and secondly since most of the underlying bedrocks were deposited before the dawn of vegetation and the marine organisms, they cannot be source rocks for the fuels.

d) Potential Mineral Resources.

Three potential mineral sources need mention here within the context of the Lake Victoria Basin Development Authority. One is the geothermal steam in the vicinity of Homa Mountains. This has not been assessed and may well be a source of energy for the surrounding area. Particularly if the production of lime were reactivated and the mining of iron ore started at Bala, the geothermal steams could possibly supply the required energy.

A second source could be found on the Lake beds and along the shores. The lake as a reservoir has accumulations of sediments transported by rivers. These sediments could contain heavy and precious minerals which after segregational deposition may be concentrated in minable layers. In addition, the shores when surveyed might provide sands for construction use and for the manufacture of glass. Furthermore on the lake beds there could be mineralised zones, hitherto not explored.

A third possible source is the Kimberlitic bodies which were recently identified in Nyamonye (Imbo), North of Maranda (Sakwa) and Nangu (Sakwa). Kimberlites are usually a source of diamond. Only in a few cases where the pressures of formation were not sufficiently high that the Kimberlites have been found to occur without being associated

with diamond. The kimberlitic bodies that have been found in Siaya district are circular in shape, having diameters of approximately ½ kilometer. They have been drilled up to 200 meters deep, where fresh unweathered kimberlitic rocks occur, but no diamond samples have been reported. Detailed petrographic studies of the cores will be able to reveal the occurrence or otherwise of diamond in association with the kimberlites.

PROPOSED EXPLORATION TECHNIQUES FOR MINERAL RESOURCES

Important mineral finds over the past decade or so point to the necessity of embarking on detailed mapping and the use of modern prospecting methods for locating sub-outcroping mineralisation. The onus of detailed geological mapping falls on the Government Department of Mines and Geology but exploration should be executed by the Development Authority. In order to try to determine the full mineral potentiality of the area, the exploration approach should take into consideration the stages and points discussed below.

a) Aerial Photography

Although most of the Basin area has been covered previously by aerial photography, much of this photography is out of date and therefore may not be suitable for modern exploration. As an initial stage, therefore, the entire area should be covered by aerial photography of suitable scale, i.e. 1.25,000. Those photographs will in turn be used to prepare mosaics and base maps for presentation of the results obtained from each element of the survey. In this way all maps will conform to (a) standard scale(s) and can be simply overlain on each other in order to make comparisons e.g. land use pattern vs. geology, etc.

b) Airborne Geophysical Survey.

In order to effectively and rapidly evaluate the mineral resource potential of the Basin area it is necessary to fully cover the area by airborne geophysical survey comprising magnetometric, radiometric and electromagnet methods.

i) Magnetometric method. The area contains a number of intrusive bodies of different geological character, some of which are kimberlitic and thus possible hosts for diamonds. The magnetic results will assist the geological mapping. In areas which have been previously fully mapped the magnetic results will help to identify hidden geological features which were not located during the mapping due to soil cover or lack of exposure.

ii) Radiometric method. The results from this method will identify areas of potential uranium mineralization. In addition, the results can be used to identify pegmatites which may be of economic interest for gemstones and industrial minerals.

iii) Electromagnetic method. The results of the electromagnetic (EM) method will identify areas containing conductive features related to possible base method deposits. In addition, it will serve as a very effective mapping tool which will delineate geological structures including faults, shear zones, etc. By producting a resistivity map it is also possible to designate areas having a good potential for fresh water acquifers.

c) Reginal Geochemical Survey.

As a first step in the ground follow-up component of the mineral resources study, a systematic geochemical survey should be carried out over the entire area. This survey will consist primarily of stream sediments sampling followed by detailed soil geochemistry in anomalous areas.

The geochemical programme will be implemented at the same time as the airborne geophysical survey at which time a complete set of base maps and photo mosaics will already be available for ground control and the plotting of results. The analytical results and anomalous areas can then be compared with the results of the airborne survey in order to identify high priority "target areas" for follow-up.

d) Final Ground Follow-up

Perhaps the most crucial stage in the overall survey is the actual follow-up. This stage should begin roughly six (6) months after the actual airborne survey has began. "Target areas" will be defined on a priority basis according to the anomalies as per the interpretation maps, the geological environment and the results of the regional geochemical programme. Each "target area will be the subject of a detailed ground follow-up using a combination of geology, geophysics and geochemistry. Based on all the above results, areas will be recommended on a priority basis for test drilling.

RECOMMENDATIONS ON POLICY AND UTILISATION

We have now presented the information available about the mineral resources of the Lake Victoria Basin area. Then the question arises what use if any can be made of them taking into consideration the stage of our development. It is apparent that heavy and sophisticated industries are

not in sight and perhaps not that recommendable. So one has to start in a humble way within the context of appropriate technology. It has sometimes been suggested that industrial (non-metallic) minerals form a very good basis for industrialisation and if the "developing" countries are to avoid the pattern of supplying raw materials and receiving in return minimum, an integrated regional approach to industrial mineral exploitation is a sound starting point. Thus initial stages should involve attempts to make finished or semi-finished products from industrial minerals.

There are three stages in the development of mineral resources. These are, firstly, resource identification, secondly, prospecting and development; and thirdly, establishment of mines which must be linked to industries producing finished or semi-finished products. To fulfil the requirements of those stages, it is critical to have an integrated approach. Furthermore, considering the limited quantities of the minerals in single deposits and their distributions, it is imperative that a mining district is developed. This means incorporating all the single small deposits in a large area within one organisation and continued exploration in the adjoining areas to the known deposits in order to extend the life of mining operation in an area.

Under the umbrella of the Lake Victoria Basin Development Authority, the second and third stages in mineral development can be executed. Recently, the Kenya government announced that plans are underway to establish a cement factory at Koru. This is a welcome development in the utilisation of the limestones available at Koru and Songhor. The factory could also be supplied with limestones from other areas. The other ingredients for cement production such as clay, pozzolana and fluorspar are available at Koru, Lumbwa and Kerio Valley respectively, which are all within reasonable distance from the proposed factory site.

Apart from the use of limestone for cement production it can be kilned for the production of lime which can be used in sugar and paper industries in Western Kenya. Again since many parts of the Lake Victoria Basin are covered by black cotton soil which is troublesome in road construction the soil can be stabilised using hydrated lime. Pozzolan from Lumbwa can also be used in the stabilisation of road materials. Such stabilisation would considerably improve the load-bearing capacity of the soils.

There is also a possibility of establising a glass factory in Western Kenya. This would utilise the known ironstones in the Basin area (particularly Bala iron deposits) and sands along the Uyoma, Kano, Nyakach and Karachuonyo lake shores. The sands will require further investigations before their suitability is ascertained.

Another possibility is the establishment of sulphuric acid processing plant. Such a plant would utilise the known iron sulphide (pyrite) deposits at Bukura and Macalder mine. Also a ceramic industry is a worthwhile project using nepheline ($KNa_3Al_4Si_4O_{16}$) from the carbonatite centres at Homa, Rangwe, Ruri, Usaki and Sokolo. This perhaps could be establised together with a glass factory at Bala near Homa mountains. Arsenic oxide required for cattle dip can be produced from arsenopyrite found at Macalder mine and Kitere.

Lastly, it must be emphasised that in order to maximise on returns from mineral development and exploitation the industries should of necessity be established close to the mineral source. In cases of dispersed and small but valuable occurrences like those of gold and silver, the authorities should encourage the local people to form themselves into co-operatives for their exploitation.

CONCLUSION

From the available mineral resources data, it is clear that some further investigations will be necessary in some cases, within the Lake Victoria Basin area. Even known deposits still require detailed assessment to determine the quality and quantity of the deposits. Due to the dispersed and limited nature of the deposits, profitable exploitation can only best be carried out within the context of an integrated regional approach, thus making the Lake Victoria Basin Development Authority a most suited organisation for developing the mineral resources.

REFERENCES

Gibson, A.B., 1954. Geology of the Broderick Falls Area. Kenya, Geol. Surv., Rep., No. 26, 45p.

Jennings, D.J., 1964. Geology of the Kapsabet-Plateau area. Kenya. Geol. Surv., Rep., No. 63, 43p.

Pulfrey, W., 1945. Geological survey of eastern Marama and adjoining areas, Western Kakamega, northern Kavirondo. Kenya Min. & Geol. Department, Rep., No. 8, 38p.

Sanders, L.D., 1963. Geology of the Eldoret area. Kenya. Geol. Surv. Rep., No. 64, 49p.

Sanders, L.D., 1965. Geology of the contact between the Nyanzian shield and the Mozambique belt in Western Kenya. Kenya, Geol. Surv., Bull. No. 7, 45p.

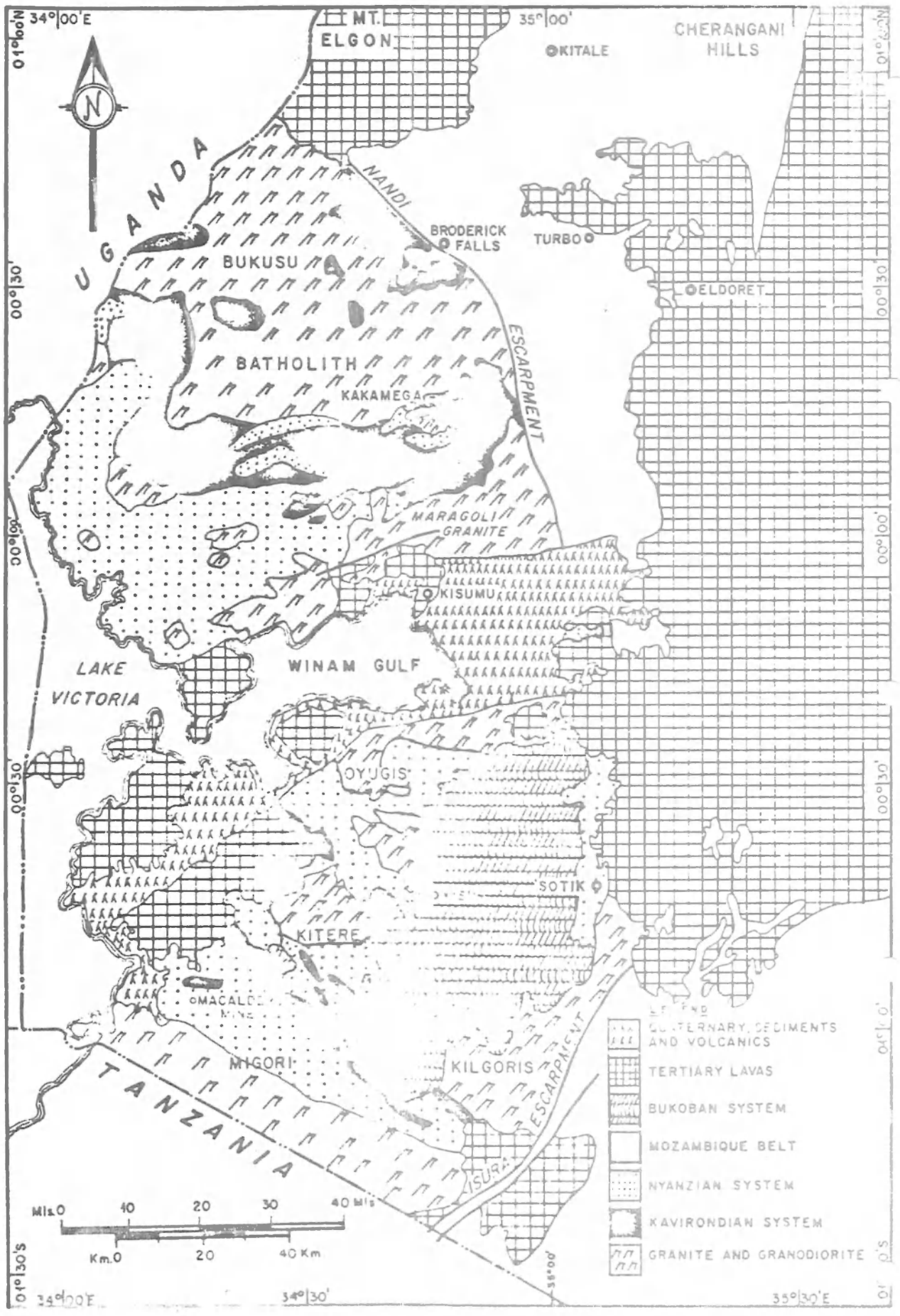


Fig. [illegible] ...with the geology of Lake Victoria Basin area of Kenya.

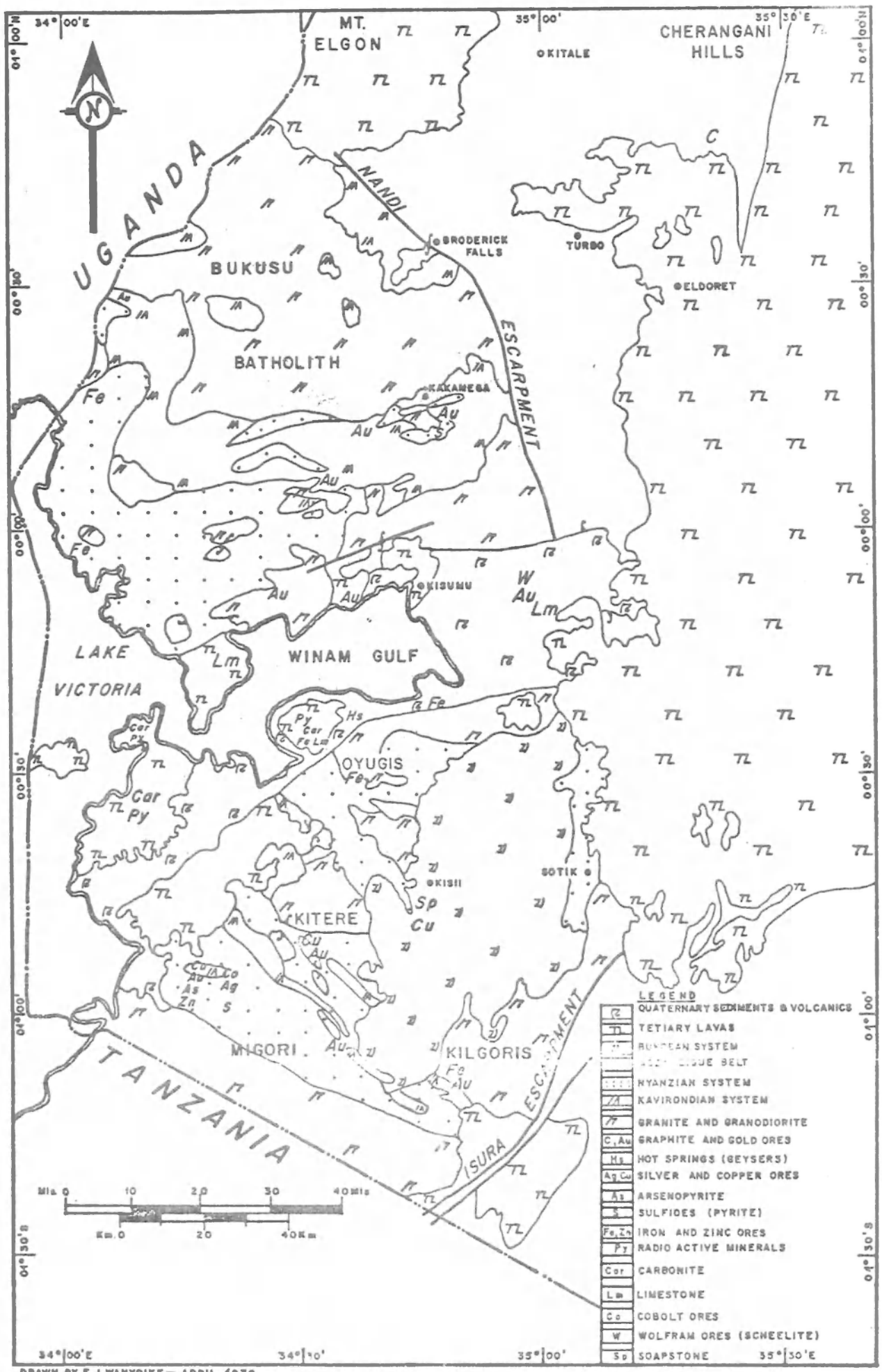


Figure 2. Map showing mineral distribution in the Lake Victoria Basin area of Kenya.

SOILS OF THE LAKE VICTORIA BASIN

By

Victor A.C. Odenyo

and

Victor P.F.X. D'Costa

INTRODUCTION

Regional planning and social and economic development in the Lake Victoria Basin must recognize the limited natural resource base to which both rural and urban development must be properly adjusted in order to ensure a pleasant and habitable environment. Land and water resources are limited and subject to grave misuse through improper land use, misuse which can lead to serious environmental problems. In such a regional planning effort, then, the selection of a desirable area wide development plan must be based in part upon a careful assessment of its effects on the supporting natural resource base.

Such emphasis on the natural resource base is essential if irreparable damage to limited and increasingly precious land and water resources is to be avoided. This emphasis, however, will require the collection and analysis of a great deal more information concerning the natural resource base and its ability to sustain rural and urban development than has been collected hitherto. Such information includes definitive quantitative and qualitative data on surface and ground water resources, human resources, forests and wetlands, fish and wildlife, agriculture, community development, industry and commerce, existing and potential historic, scenic, scientific and recreational sites, environment and health, geology, and on soils

1.1 Need for Soils Studies

Soil properties exert a strong influence on the manner in which land is used. Soils are an irreplaceable resource, and mounting pressures upon land are constantly making this resource more and more valuable. A need exists, therefore, in any comprehensive regional planning program, to examine not only how land and soils are presently used, but how they can best be used and managed. This requires an areawide soil survey which shows the geographic locations of the various kinds of soils, identifies

their physical, chemical, and biological properties, and interprets these properties for land use planning. For the Lake Victoria Basin soil surveys of varying details have been carried out at different times and for different purposes as discussed in the following pages; but an areawide inventory of soils including surveys for the hitherto unsurveyed areas, is indispensable.

For planning application, the necessary soils suitability study should be designed to permit preliminary assessment of:

1. The soil-plant relationships and suitability for agricultural and non-agricultural uses;
2. The engineering properties of soils as an aid in the development and selection of desirable land uses;
3. The suitability of soils for transportation facility location; and
4. The location of potential sources of sand, gravel, and other mineral resources.

Such an areawide soil suitability study and assessment does not elimunate the need for on site investigations and laboratory testing of soils for the final citing of specific land use types.

1.2 Objectives

The objectives of this paper are (1) to show what is available concerning information on the soils of the Lake Victoria Basin, (2) describe broad characteristics of the soils, (3) assess the soils, on the basis of information available, for various crops and agriculture practices, and (4) make suggestions on future activities concerning inventory and use of the soil and other related land based resources.

2. DEFINITION

"Soil" is a term which means different things to different people. To a houseowner it is the "dirt" which sticks to the shoes, clothes, and the floor and which must be removed. To the mining engineer the soil is the debris covering the rocks or minerals which must be removed, while to the highway engineer the soil may be the material on which the roadbed is to be laid. The ecologist may consider the soil as a sub-system within the wider ecological system making up the environment. To the farmer the soil is the habitat for plants. He makes a living from it and is thereby forced

to pay more attention to its characteristics. To a soil scientist, "Soil" is the collection of natural bodies on the surface of the earth. It contains living matter and supports or is capable of supporting plant life. Its upper limit is air or shallow water. Laterally, it grades to deep water or to barren areas. It is bounded at the lower limit by material not considered soil.

This is the definition adopted for this paper. Individual soils are studied via soil profiles (Fig. 1). The descriptions and designation of profile characteristics have been standardized to facilitate communications among soil scientists and soil users.

3. SOIL FORMATION

Soil forms as a result of the interaction of five factors, each of which may to a lesser or greater degree leave its imprint on the resulting soil.

3.1. Climate - especially temperature and precipitation, which affect the nature and rate of weathering through their influence on chemical reactions and biochemical change. Soils cannot develop without weathering!

3.2. Parent Material - which influence the chemical and mineralogical composition of the resulting soil, the texture and structure, the downward movement of water, and the natural vegetation. Even in humid regions, where the intensity of weathering is high the influence of parent material on even mature soils may still be profound.

3.3. Living Organisms - especially the native vegetation, which influence accumulation of organic matter, profile mixing, nutrient cycling, and structural stability. The soil fauna are vital for the chemical and biochemical decomposition of vegetative litter. Man, through his land-use activities, causes both harmful and beneficial effects on the soil by clearing natural vegetation and cultivating the land; accelerating erosion through burning, cultivation, and indiscriminate grazing; and altering the character of profile development with such agricultural practices as cultivation, puddling, use of manure, cropping systems, fertilisers, drainage, irrigation, and reclamation.

3.4. Topography - which, through elevation, slope, and depth of water table, may hasten or delay the work of climatic forces and influence water retention and surface erosion. In local areas topography may be the major controlling factor.

3.5. Time - which is reflected in the youth, maturity, or senility of soils (the relative degree of development), indicating the length of time (geological time) materials are subjected to weathering.

4. SOIL SURVEYS

The function of a soil survey is to classify, locate on a map, and describe the nature of soils as they occur in the field. Classification, especially of complex natural bodies such as soils, requires detailed knowledge about them to enable accurate determination of the range and limits of the characteristics used in defining and describing the units of classification.

Soil surveys are of four types, usually involving the same methods but differing in intensity and thus in the amount of details of the information generated:

4.1. Exploratory Soil Survey - is done at small scales (1:500.000 or smaller) for the purpose of establishing major soil regions. Similar soil regions can then be further investigated. Soil-Landscape association are described.

4.2. Reconnaissance Soil Survey - is also done at small scales (1:000,000 - 1:250,000). This is a systematic inventory of soils and land resources, and the results can be used in multipurpose rural land use planning for farming, range management, soil conservation, and many others.

4.3 Semi-Detailed Soil Survey - is done at medium scale (1:20,000 - 1:50,000). In Kenya, these are usually done for project feasibility studies or for the development of a selected land use, e.g. Sugar-cane growing. They are used for assessing soil and land suitability for the selected land use and, where necessary, alternate land uses. They involve more intensive field observations, mainly on soils and soil management problems, and more laboratory analyses.

4.4 Detailed Soil Survey - this is done at large scales (larger than, 1:20,000). They are used for farm planning, irrigation projects, or for characterization of research trial sites. They involve very intensive field observations and laboratory analyses, including fertility testing. Mapping units coincide with phases (slope, stoniness etc) of soil series. These are soil bodies having horizons essentially similar in characteristics and arrangement, in a soil profile developed from a particular type of percent material. But they may slightly differ in topsoil texture.

5. SOIL SURVEY IN THE LAKE VICTORIA CATCHMENT AREA

The Kenya Soil Survey recently concluded an exploratory soil survey for the entire country. In addition to the exploratory survey covering the entire 4,600.000 hectares of the basin, many other larger scale surveys have been done in different portions of the basin. Figure 2 shows areas which have been surveyed at reconnaissance level. These include the whole of South Nyanza and most of Kisii districts; the whole of Maseno Division in Kisumu District; and Potions of Trans Nzoia, Uashin Gishu, and Elgeyo Marakwet districts. The whole of Trans Nzoia district has additionally been covered in a separate survey. Most of Siaya and parts of Bungoma districts will be covered in the survey currently in progress. These areas add up to approximately 34% of the basin.

Figure 3 shows areas which have been surveyed at the semi-detailed and detailed levels. The semi-detailed surveyed areas include the East Konyango area in South Nyanza, the Kano Plains, Songhor and Muhoroni areas in Kisumu district, and the Mumias, Nzoia, and West Samia areas in Western Province. These areas add up to approximately 9% of the basin.

The nuclear estates of the sugar development areas have been surveyed in detail. In addition, there are five areas in South Nyanza and Kisii districts which have been surveyed in detail as a part of the training programme in tropical pedology of the Agricultural University in Wageningen, the Netherlands. These are located in the Mfangano, Mbita, Rongo, Irigonga, and Marongo areas. Many small areas surveyed in detail, for example soils of research stations, are not shown in Fig. 3. Areas surveyed in detail add up to approximately 1% of the basin.

Completed and on-going soil surveys in the basin are listed in Table 1.

6. MAJOR SOILS OF THE CATCHMENT AREA

6.1 General: As Fig. 3 shows, the range of soil information available for different parts of the basin is very wide. Very detailed information is available for a few areas while only exploratory information is recorded for most of the area. This situation makes it impossible to discuss the soils of the basin from the point of view of their taxonomic classes. Therefore, they will be discussed according to broad groups related to the five factors of soil formation.

Table 1: Completed and on going Soil Surveys in the Lake Victoria Basin[1]

Worker and Year	Map Scale	Location	Area in ha	Purpose
	RECONNAISSANCE			
Dept. of Agric (1959)	1:50,000	Sotic	7,000	Irrigation
Makin & Nyandat (1965)	1:50,000	Lambwe Valley	32,000	Settlement
Agric Univ. Wageningen 1974	1:250,000	S.Nyanza, parts of Kisii & Narok Dist.	960,000	General
	SEMI-DETAILED			
Gibbs & Partners (1956)	1:50,000	Nile Basin incl.Kano Plains & Yala Swamp	115,000	Irrigation
Thorp et.al. (1960)	1:50,000	Songor	52,000	Sugarcane
Thorp et.al. (1961)	1:50,000	East Konyango	39,700	Sugarcane
Makin & D'Costa (1966)	1:50,000	Mumias	21,000	Sugarcane
	1:50,000	West Samia	9,600	Cotton
Nyandat & Osweggo (1969)	1:12,500	Turbo	10,260	Afforestation
D'Costa (1970)	1:50,000	Kano Plains*	75,000	General & Irrigation
D'Costa & Jaiswal (1975)	1:50,000	Awendo outgrowers	20,000	Sugarcane
	DETAILED			
Makin & D'Costa (1966)	1:5,000	Anero	1,400	Irrigation
	1:3,100	Bunyala	300	Irrigation
	1:12,500	Mumias	10,000	Sugarcane
D'Costa & Nyandat (1968)	1:3,125	Kibos	160	Res. Station
D'Costa & Jaiswal (1975)	1:8,000	Awendo	4,000	Sugarcane
D'Costa (1970)	1:12,000	West Kano II	1,800	Irrigation
Agric. Univ. Wageningen	1:12,500	Irigonga Area	2,100	General
Agric. Univ. Wageningen	1:12,500	Marongo Area	10,000	General
Agric. Univ. Wageningen	1:12,500	Magomba Market Area	3,340	General
Agric. Univ. Wageningen	1:12,500	Mbita Area	1,000	General
Agric. Univ. Wageningen	1:12,500	Sena and Ukula Area	475	General

*Mapping in this survey is detailed. The maps are available in the geography Department, University of Nairobi.

1. Source: All except the last 5 from D'Costa, 1973.

The influence of climate, parent material, organisms (especially vegetation), topography and time is evidenced in the range of soils found in the basin. Annual rainfall ranges from less than 650 mm (25 in) in the Western part of the Uyoma peninsula to more than 1900 mm (75 in) in the Kisii, Kakamega and Kericho areas. The rainfall falls to below 650 mm again in the Loita plains in the Narok district. At least 80% of the basin receives rainfall of between 650 mm (25 in.) and 1500 mm (60 in). Mean daily temperatures for most of the basin range between 20°C. and 35°C.

Climax vegetative cover range from sparse grassland in the Loita plains through tall grassland and savanna woodlands to dense forests in the Mau, Kisii, Kakamega-Nandi, and Elgon areas. Except for the lowlands around the lake, which are pleistocene to recent, the basin is tertiary or older. Parent materials are mostly of volcanic origin, comprising phonolites of different composition, granites, basalts, rhyolites, tuffs, and others. The parent materials in the plains and other alluvial areas are of mixed composition consisting of mixed sediments from various rocks. Slopes range from level and gently sloping in the plains through steep slopes in the mountains to precipitous slopes along the escarpment flanking the Nyanza Gulf.

6.2 The Major Soils: The following discussion of the soils will follow roughly the relief or agro-ecosystem. Those of the low-lying areas are discussed first, followed by soils of the higher elevations. The low lying areas should be taken to mean the level to gently sloping lands surrounding the Nyanza Gulf.

6.2.1 Soils of the Swamps: There are three major swamps associated with rivers in the downwarped lowlands. These are the Yala swamp located in Siaya/Busia districts, the Kibos swamp just south of Kisumu town, at the mouth of the Kibos river, and the Miruka-Nielbiego swamp at the mouth of river Nyando. The latter two are in Kisumu district. The Ombei-Luanda swamp, associated with the Luanda river, is also in Kisumu district, some kilometers north of Ahero. There are other smaller swamps. In addition, the Nyanza Gulf shore is flanked by seasonal and permanent swamps for most of its perimeter.

Making soil surveys in swamps is a difficult exercise. Initially, most information is derived by examining edges of swamps. Inner sections are not normally surveyed until they are drained. The Kibos, Miruka-Nielbiego and Ombei-Luanda have been surveyed by D'Costa (1973). The Yala swamp was first surveyed by A. Gibb and Partners (1956) and is currently being surveyed in detail.

Swamps soils are young and have no horizon differentiation. They can be divided into two groups: those of the inner permanent swamps and those of the seasonal swamps, on the slightly higher grounds surrounding the permanent swamps.

6.2.1.1. The Permanent Swamps: The permanent swamps are flooded throughout the year to depths of up to 1 m. or more. The soils consists of medium to heavy clays, with clay contents varying between 45 and 80% (Gibbs and Partners, 1956). A variable layer of raw organic material and a dense but shallow mass of roots are often present on the surface. They are very dark grey or black in colour, and are massive with no structure. They are soft, plastic and sticky; and are generally deep. The surface reaction is slightly acid to neutral. Dense Cyperus papyrus is the dominant species of vegetation in the permanent swamps. The Yala and Miruka swamps also contain localized pockets of course textured soils which may be saline or alkaline. The drained swamps would largely comprise of peaty soils (Histosols) and young variable textured, predominantly mottled, clayed Entisols.

6.2.1.2. The Seasonal Swamps: These are flooded for several months during the year to depths varying from several centimeters to a half a meter or more. Because of the alternating wetting and drying they have formed weak to strong, coarse, blocky structure. They crack deeply during the dry season, and are thus self churning (Vertisols). D'Costa has recognized three units in the seasonal swamp areas of the Kano plains: (1) Those lying on the lower alluvial flats with extensions to the permanent swamps, which are permanently water-logged, mottled almost to surface, slightly acid to neutral, and are non saline/alkaline. (2) Those lying along the swamp fringes on the lower parts of the plains, which are clay loam to light clay in the surface layer, with clay content increasing in the subsurface. They are distinctly mottled below the surface, and are slightly acid to neutral, the pH increasing with depth, and (3) Those located on the higher lying swamp fringes, which have very dark greyish mottled clay in the surface 10-20 cm. grading to black heavy clay below it, and very strong coarse blocky structure. They have a strongly alkaline reaction, sometimes up to the surface layer. The dominant clay in the swamp soils is montmorillonite.

6.2.2. Soils of the Plains and Plain Fringes: These soils lie in the lowlands between the swamps on the lower elevation and the rolling and undulating uplands on the higher. Most of these areas receive less than 1300 mm. (50 in.) of rainfall annually. The parent materials are of mixed origin, but are either alluvial, lacustrine, or colluvial, or a mixture of these.

The plains proper contain soils developed from alluvial/lacustrine parent materials. The levees, both ancient and recent, contain soils ranging in surface texture from silty clay through sandy clay to sandy loam. Their profiles are generally varied and of mixed texture, with no definable horizon differentiation (Entisols). Their surface reactions range from acid to neutral, while in the subsoils they are neutral to alkaline. They are generally low to adequate in nutrient status, especially Ca, Mg, K and P, but marginal in Nitrogen. They are dark brown to dark greyish, and they are freely drained, with good physical characteristics and friable surface layers. D'Costa (1973) recognized seven soil types within this group in the Kano plains. Similar soils were also mapped by Thorp et, al. (1960) in the Songhor area.

The most extensive soils in the plains are those of the basal alluvial areas, occupying the wide flat stretches which formed the original base levels for alluvial deposition. Their textures range from clay loam to clay, and are normally uniform throughout their profiles. They are dark brown, very dark grey or black, cracking, intractable, montmorillonitic clays (Vertisols). Their clay content, especially in depressed areas, may be over 70%. These soils have an acid to neutral topsoil and neutral to alkaline subsoil and are non-saline. They have adequate Ca, Mg, K and P, but generally low to marginal N. The soils are deeper than 1 meter, and in dry seasons have cracks 2 - 10 cm wide and reaching deeper than 1 meter. Thus they have a self churning characteristic.

In the upper fringes of the plains, on gentle and moderately sloping lands rising towards the hills and escarpments, are located a different group of soils. The soils within this zone vary among themselves according to their topographic location. They have colluvial or a mixture of colluvial and alluvial parent materials.

In the lower and middle slopes of the colluvial area are soils wit uneven, sloping topography and, because of slopes, are subject to gully erosion. They are dark brown to very dark greyish brown, with variable textures, ranging from sandy loam to sandy clay in the surface layers, but generally mixed throughout the profile. The subsurface has variable amounts of gravel. They have friable surface horizons, with firm blocky to subangular blocky sub-surface and moderate to slight permeability. Their surfaces are acid to neutral, with neutral to strongly alkaline subsurfaces. Their contents of Ca, Mg, K and P are fair to adequate, but they are generally low in Nitrogen. The soils in this transitional area include Vertisols and Entisols, which ar slightly coarser textured and better drained than the soils of plain proper.

In the upper slopes of the colluvial area, the soils are latosolic. They have dark reddish brown sandy loam to sandy clay loam textures, with dominantly kaolinitic clays in the finer fraction and quartz in the coarser fraction with illite and muscovite in the silt fractions. They have loose, friable consistency and crumb surface. Their drainage is free. The surface are slightly acid, with subsurfaces acid to neutral. They have medium base saturation, but with marginal available nutrients.

On the micro ridges of the plains are a complex of soils underlain by mudstone. The mudstone occurs at different depths in different locations, ranging between 5 to 120 cm below the surface. The soils have very dark brown to very dark grey sandy clay loam to clay surfaces. The surface layers above the mudstones are fine to gravelly. The soils are the cracking type (Vertisols), of varying depths with cracks normally reaching through the mudstone subsurfaces. Permeability of the surface layer is slow, and the mudstone subsurfaces are impermeable. The surface layers have a neutral reaction, while the mudstones are commonly alkaline. The surface layers normally are low to medium in nutrients, but generally low in magnessium.

On the footslopes of the escarpments, and surrounding Kisumu town, are shallow soils occuring in scattered pockets in between outcrops of bedrock and laterite. These soils have dark brown to very dark loamy to gravelly cracking clay surfaces which grade into indurated iron-stone (laterites) within a depth of 30-60 cm. The concretionary ironstone overlies the phonolite bedrock. The soils have a slightly acid reaction. They have fair to adequate nutrient status, but are generally too shallow to cultivate.

In summary, therefore, most soils of the low-lying areas are dark cracking clays (Vertisols), with localized areas of Entisols and lateritic soils. Some are saline, some strongly alkaline, while others are neutral. The differences in the properties of soils result from the dominating influence of one or more of the soil farming factors: climate, parent material, relief, and organisms. All these soils are young.

About one third of Narok district lies within the basin. A small portion of the district, West of the 35°E. latitude and outside the Maasai Mara Game Reserve was covered in the reconnaissance soil survey of South Nyanza and Kisii districts (Agric. Univ. Wageningen Report No. 1); the rest of the area has only been covered at the exploratory level. The plains in the central part of the district, Loita plains, have soils similar in many physical and morphological characteristic to the soils of the lowlands around lake Victoria. They, however, have different parent materials, being developed

from volcanic ashes and pumics from recent volcanoes. These soils are also of the dark cracking type, developed under grassland climax vegetation. They are mostly poorly drained, and xeric in many places, especially in the central part of the plains.

To the west of these plains, and covering a substantial area east from the old Mara bridge are also similar poorly drained, very dark grey brown to black soils, predominantly cracking clays, (Vertisols), developed on basic igneous rocks.

6.2.3 Soils of the Upland's and Highlands: The rest of the basin will be discussed in two parts. First, the Uplands region defined as that region stretching from the upper edges of the plains at the lower end to elevations of about 1520 m. (5,000 ft.) above sea level will be considered, followed by the rest of the higher ground, herein termed the Highlands.

6.2.3.1 Soils of the Uplands: The region between the plains and 1520 m. has various kinds of shallow to moderately deep reddish brown to red latosolic soils, and some stretches of Vertisols and gleyed soils (Glaysols) in low-lying areas. The soils may be deep in some places. The soil characteristics are tempered in various places by the parent materials and drainage or topographic location. They are generally shallow on steep slopes, deeper on gentle slopes, and of varying depths in valleys. Where Basalt is the parent material, as in the area north and north-east of Kondiegi near Kabondo (Agric. Univ. Wageningen Report No. 1), and in the area around Maseno (Muchena, 1976) South Nyanza (D'Costa and Jaiswal, 1975) the soils are moderately deep to deep, dark reddish brown, permeable, friable clays. They are normally well drained. A dark, humus-rich layer is rare in these soils, while surface sealing and structure deterioration in the surface layers is common. In places, iron and manganese concretions are found at depths between 60 and 100 cm. in soils which have not been truncated. Physical conditions of the soils are normally good, but chemically they are rather leached. They are acid in reaction.

Where granite is the parent material, as in the areas east of Asumbi and South of Oriang', along the escarpment east of Kendu Bay, in the region around Ramba and Kabondo and in a large part of Seme, Mumias, Bungoma and Samia, the soils are reddish to dark brown, coarse to medium textured and shallow to moderately deep. They are well drained except in low-lying flats and stony or rocky areas. Ironstone or murram is common in these soils, usually occurring within 50 cm. of the surface. A good

example of these soils is the Magima loamy coarse and sand described by Bellis et. al. (1961) around the Magima market in the East Konyango survey. The Magima coarse sand is a shallow to moderately deep, well drained, dark reddish-brown soil formed on granite. Hard layers of laterite are found anywhere from the surface to 60 cm. below the surface. These soils are low in fertility for all essential nutrients, but have good physical characteristics. Because of shallow depths and coarse textures moisture may also be inadequate for crops during dry spells in the growing season.

Additional rocks forming parent materials in this region include rhyolite, diorite, andesite conglomerate, and others. Soils developed from these are varied in characteristics, but are mostly shallow. Also, occurrence of ironstone is very widespread, and appears anywhere from the surface to 50 cm. below the surface. The ironstone impedes drainage, contributing to high surface runoff and erosion. Rock outcrops are also common.

Where drainage is impeded as in low-lying flats, soils are dark greyish brown to black with medium to heavy textures (Vertisols and Gleysols). The surfaces are very susceptible to sealing, considerably reducing permeability.

Soils of medium to heavy textures also develop on alluvial materials along rivers and other depressions. The textures often reflect the rock sources of the alluvial materials.

6.2.3.2 Soils of the Highlands: The next region to be discussed is that above 1520 m (5,000 ft.). Most of this region receives more than 1500 mm (60 in.) of annual rainfall, rising to 1780 and 1805 mm (70 and 75 in.) in the Kericho and Kakamega areas respectively, and to above 2030 mm. (80 in.) in the Kisii highlands. Characteristics of soils in this region reflect the effects of climate, parent material, and topographic location.

Most of this region is unsurveyed at scales larger than exploratory. The survey done for the Awendo sugar project covered some small areas of this region. Other surveys are the reconnaissance survey of the Kapenguria area and South Nyanza and Kisii districts, the site evaluation of Trans Nzoia district, and the various detailed surveys done in small areas in Kisii and South Nyanza districts by the students of Agricultural University, Wageningen. This region includes some of the most significant cash crop areas such as Kisii highlands, Kericho and Nandi Hills-Kapsabet area and Trans Nzoia.

Typically, soils of this region are moderately deep to very deep, and reddish brown to red Latosols (mostly Ferrasols and Nitosols). They are characterized by a high infiltration rate and a strong structure stability, especially where an organic-rich top layer is present, as under forests. These conditions mean that surface runoff occurs only at high rainfall intensities, except in cultivated areas. The large amount of rain water infiltrating into the soil makes for highly leached soils and deep weathering. The soils are deepest in level to gently sloping land scapes, and shallowest on very steep slopes or where very resistant rocks occur. The strong effect of climate tends to overshadow those of other factors; however, these are also quite evident in many ways. In the Kisii area, quartzites, where they occur, form ridges due to their resistance. Soils from quartzites have generally less stable structures (Agr. Univ. Wageningen, Report No. 1) and less organic matter. They are generally deep, yellowish red to red, clay soils, with weak subangular blocky structures (Ferrasols) as recognized in the Marongo area (Agr. Univ. Wageningen, Report No. 3). The soils have higher sand content when granite is the parent material, and are susceptible to sealing. The structure is generally stronger where basalt is the parent material, with a thick, organic-rich surface horizon on level to gentle slopes. Clay cutans are continuous through the profile (Nitosols). In depressions of nearly level to undulating plains are found shallow to deep dark brown to dark grey clay soils, with gley mottles and a moderate to strong structure (Gleysols). These depressions are poorly drained and the soil is waterlogged during part of the year.

On andesite parent materials, such as found in the Magombo Market area in Kisii district, the soils are well drained, fine to very fine clays with thick humus-rich surface layers. In the Kericho area, Kericho Type phonolite is the dominant parent material. The soils are deep to very deep, with thick organic rich surface layers, especially under forest. They are clayey, with good permeability (Odenyo, 1970). Volcanic ashes and tuffs are the major parent materials in the Mau area. Soils information is very scanty, but they are generally red friable loams to clays under forest.

In the Elgon area, agglomerates, breccias, tuffs, basalts, gneisses and quartzites form the major parent materials within the catchment area (Gelens, et.al. 1976 and Siderius and Njeru, 1976). On the mountains and major scarps in this region, well-drained, deep, dark red, friable clays with thick organic-rich surface layer develop on pyroclastic rocks. On various gneisses and quartzites in the hills and minor scarps are similarly deep, brown to dark reddish brown, friable, sandy clay loam to clay with a

very thick organic-rich surface layer changing to silty clay loam on pyroclastic rocks (Andosols). The colluvium on footslopes give rise to sandy clays.

In the upland areas, gneisses and quartzites give rise to well drained, predominantly deep, dark reddish brown to dark brown, friable sandy clay loam to clay, with deep to very deep organic-rich surface layer, with similar but very friable to friable predominantly clay soils on undifferentiated Basement System rocks at lower levels. On river terraces and flood plains, the soils are imperfectly drained, very deep, mottled, dark greyish brown to brown sandy clay to clay, and on bottomlands and minor valleys the soils are similar but poorly drained, dark grey to greyish brown, gleyed, and in places calcareous in the subsoil. Very firm clay, deep, black soils of the cracking type are also found in these bottomlands.

In summary, therefore, the two regions above the lowlands are characterised by well drained reddish brown to red, friable soils in the hills and upland positions, and dark grey to black soils in areas poorly drained, which may occur both in valleys and bottomlands, and locally in upland positions. These latter soils are often gleyed and may be calcareous in places. Parent materials cause variations in texture, depth, structure, and other characteristics. Also, the higher rainfall uplands and hills are characterised by thick to very thick organic-rich surface horizon, especially where the soils have not been subjected to extended periods of cultivation.

7. SUITABILITY OF SOILS OF THE BASIN FOR AGRICULTURE

Soil survey findings are interpretation of prediction of performances and not precise recommendations for use of soils. The suitability of soils, in addition to their characteristics, qualities and crop responses, is also dependent on many economic, environmental, social political or even religious considerations. Soil survey reports together with technical grouping of soils according to management practices are necessary in classifying land and selecting a type of land use. Land, in an economic sense has many attributes other than soil characteristics and includes the size of tracts or potential tracts, its relation to water, other land, to transport and to markets. Preference of the owner or the operator in terms of capital, skill and viability of the venture, also play an important part in selecting a type of land use, cropping system and soil management practices.

In this section, the suitability of soils for agriculture is discussed mainly on the basis of soil characteristics and adapted crop practices, and where necessary other factors of importance are noted. Furthermore, this discussion is generalized for two types of land use, namely (1) rainfed agriculture and (2) irrigation, to include both small scale or large scale farming. The suitability of soils, which were earlier grouped on physiographic (relief) or agro-ecological pattern, are discussed in that order.

7.1 Soils of Permanent Swamps: These areas consisting largely of varied depths of organic mass overlying mottled clays (Histosols) with pockets of lighter textured levee soils (Entisols), are idealy suited for irrigated agriculture because of their flatter expanses and natural promixity to water. The major swamps (Miruka and Yala) enbracing some 16,000 ha. afford large scale irrigation settlement for the nearby already dense population. These areas, however, require costly reclamation, drainage, dyking and flood protection measures. Following reclamation, the implementation of any irrigation layout and cropping system would necessitate a period of more than one or two years for decomposition and subsidence of organic trash and the resortment of natural base level. A concurrent Research Station or Pilot Scheme should look into feasibility of adaptable cropping and cultural practices to follow. Sugarcane, cotton, maize, sorghum, legumes and vegetables appear the best crops suited for these reclaimable areas. The inclusion of fish hatcheries in the settlement should also be considered. Because of the heavy costs of such a programme, government full participation would be desired.

7.2 Soils of Seasonal Swamps: These soils, flanking the upper fringes of permanent swamps comprise mainly of dark intractable clays (Vertisols) with minor pockets of mottled clays (Gleysols) and localised light textured levee antisols. These soils, owing to their wide flat expanse and easily available natural source of water, are well suited to irrigated agriculture (e.g. West Kano II). Provision of proper irrigation and drainage layout, flood control measures, protective dykes (for rise of lake levels) are necessary. Since the main soils are poorly permeable and easily puddled clays, paddy rice appears best suited for cultivation during wet season with maize, sorghum, legumes (soybeans), followed in dry season rotation. Deep rooting crops, sugar cane and cotton would necessitate soil amendments, such as deep ripping, ridging and furrow or cumber-bed cultivation. Sugar cane cultivation, has proved economically viable on these soils, particularly on lighter

clays and entisols (e.g West Kano). Rice and cotton, with Government induced pricing subsidy as employed for sugar cane, could result in a production boom given proper husbandry. Small scale viable farms with least disruption of the original inhabitants could be tried, unlike the Kano II Scheme implementation, since population density is much less in these areas. A few families with meagre parcel of land could be engrossed in the reclaimed permanent swampland. Experience gained in the irrigation layout and cropping practices of West Kano, could be applicable to these similar areas of seasonal swamps. Although economically less viable, improved mixed farming under rainfed conditions may be pursued with flood protection measures. Presently dry season grazing of subsistence level is a common site on these seasonally flooded or drought stricken areas.

7.3 Soils of Basal Plain Areas: These level to gently sloping lands, stretching from Lake shore swamps of footslopes of hills and escarpments, consist largely of dark cracking clay Vertisols. These soils, owing to their wide, nearly flat extent and abundant natural resource of water, are idealy suited to irrigated agriculture, particularly paddy, grown under puddled nature of soils. As with soils of seasonal swamps, maize, sorghum, legumes, (soybeans, groundnuts) should be included as second crop in dry season rotation. Cotton and sugar may be supplemented for paddy with soil improvements. The lighter clays and coarser, more freely drained fluviatile Entisols, are better suited to sugar cane, and cotton, including bananas. The higher lying light textured, old levee or beach soils, (e.g Rabuor, Nduru ridge - Kano Plains) are densely settled and should be reserved for housing settlement. Likewise higher lying shallow mudstone soils, being above food level, afford better site for housing. Flood protection measures embarnkment of rivers, control of irrigation discharges and building of water reservoirs must be taken into account. It is envisaged that small scale irrigated farms of viable size could be established. Families to be displaced should be provided land in reclaimed swampland. Experience gained in cropping, cultural practices, irrigation layout and management aspects of Ahero, Bunyala and Kano II Pilot schemes, should be employed for these areas. Mixed cattle farming could be tried with better pastures, especially adaptable on Mudstone soils e.g. Wawidhi - Nyalenda areas. Fish farming should be encouraged in the settlement schemes.

7.4 Soils of Footslopes of Hills, Escarpment of Colluvial Areas: These soils, lapping the upper fringes of plains, are variable types from very stony or shallow lateritic (indurated ironstone) soils to deeper young reddish latosols and intermixed vertisols and entisols. The lateritic soils (e.g. Kisumu,

Waradho, Asembo) are obviously too shallow or stony for arable agriculture and provide better foundation for communication, housing and other construction purposes with garden shambas. These soils are densely settled. The colluvial/alluvial vestisols, entisols and latosols generally have better drainage status than soils of plain proper, and are therefore suited to cultivation of deeper rooting crops such as sugar cane (Miwani, Chemelil areas) and cotton (Asembo) with improved husbandry. These sloping areas require soil conservation measures. The rainfall, although increasing with altitude from the Lake, is rather unreliable and erratic and therefore provision for supplementary irrigation from upstream reservoirs and boreholes should be taken into account. Drought resistant crops such as cassava, potatoes, legumes and sorghum should be included together with such other crops as bananas, maize and vegetables, in management practices. Many areas (Miwani, Chemelil) are suited for irrigated agriculture. Both ridge and furrow and overhead irrigation would be required.

7.5 Soils of Hill Slopes, Plateous and Highlands: The uplands comprise of variable soils dependent largely on the influence of parent materials and topography, with cropping practices influenced by climatic inclements. On steep slopes are found the non-arable lateritic or shallow stony or rocky soils. On moderate to gently rolling topography with high rainfall pattern, occur deep, reddish, friable latosols- fertile Nitosols on Basic rocks and less fertile Ferrasols on acid (sandy) igneous materials. These soils, with good drainage and physical properties provide ideal conditions for sugar cane cultivation. (e.g. Mumias, Nzoia, Awendo, Chemelil-Muhoroni-Songhor Belt). Cotton culture is also feasible in this region, particularly on lower slopes and lower rainfall belts (Siaya, South Nyanza, Elgeyo Marakwet and Kisumu districts). Still, at higher elevations (above 1520 m) with higher rainfall as in Kericho, and Nandi Hills, tea and locally pyrethrum, are the most suitable crops on these well drained soils. and presently under large scale rainfed agriculture.

In valley bottoms and depressed situations of uplands are found imperfectly to poorly drained mottled clays (Gleysols) and vertisols in relatively drier areas. These soils have some permeability and with proper drainage measures are suitable for sugar cane, cotton and a variety of subsistence crops. The high rainfall uplands, apart from intensive agriculture also offer good natural potential for forestry, whilst the depressed grassland have potential for stock grazing with emphasis on mixed farming. These areas would need good soil conservation measures particularly on steeper slopes and land cleared of forests for cultivation.

Because of the erratic nature of rainfall, supplementary irrigation from nearby rivers or boreholes, should be taken into consideration if intensive farming is envisaged for these areas.

7.6 Other Possible Crops: Most of the crops discussed are extensively cultivated in the basin area. Coffee is another cash crop not discussed above which is extensively grown, mostly in the Kisii and Kaimosi areas of the region. Coffee could be expanded to areas beyond these, where soil and climatic conditions permit. These include areas in Elgeyo Marakwet, Siaya, and South Nyanza districts.

Other cash crops, which are not currently commercially grown in the region, but which would be possible given the soil and climatic conditions, are pineapples and tobacco.

Pineapple thrives on sandy, sandy loam, clay loam, lateritic, and peaty soils, which are widespread in the basin. The soils need to be of reasonable depth as good drainage is essential, and generally need to be acid, with a pH between 4.5 and 6. the optimum temperature range for the fruit is 21-32°C, and they are fairly drought resistant, the minimum acceptable rainfall being only 750 mm (30 in) per year. These conditions pertain in many areas in the basin, especially within the "Uplands" region described earlier.

Although precise information is not available to the authors at the time of writing, it has recently been reported that a local tobacco company has been considering encouraging the production of tobacco in parts of the basin. Presumably investigations will be carried out to determine to what extent this may be possible. Tobacco is a deep-rooted plant, but a low-nitrogen product. There must be adequate nitrogen during early stages of growth, but low or non-existent during the latter part of the growing season. Soils should be deep (120-150 cm), of medium-coarse sands or sandy loams on the surface, underlain by a fine sandy loam or sandy clay. They should be slightly acid, with pH between 5.5 and 7. Altitudes should be between 1000 and 1500 meters (3000 and 4500 ft), and rainfall should not exceed 1100 mm (45 inches).

These conditions are met in many areas of the "Uplands" region of the basin. In fact, Collins (1954) reported that many areas in Nyanza and Western provinces were suitable for growing fire-cured tobacco, These areas included Samia, Bukusu, Ukwala, Uranga, Asembo Bay, Akala, North Nyokal, Mariwa, Butende, Suna, Sakwa, Alego, and Utrotso. These areas need to be examined further.

7.7 Management Questions: The existing research stations are continuously looking for solutions to management problems in the commercially farmed areas within the basin: Tea estates, coffee farming, sugar-cane farming, and more recently, irrigated paddy rice cultivation. However, small-scale cultivators do not have research stations to back them up. It is in these areas where serious soil degradation is taking place, especially because of lack of soil conservation practices.

The most serious problem in these areas is soil erosion, which results from both cultivation and grazing practices. Allan (1967) observed that in addition to the dense population of the present Nyanza and Western Provinces, "the province has to support over two million cattle, mainly stunted and half-starved scrub stock, a number vastly in excess of the carrying capacity of the grazing". If anything, the acreage of cultivated land has increased, with a corresponding decrease in grazing land, since that observation was made. Human population has increased, and, even in the absence of hard data to prove it, animal population has probably increased too, at least by a small margin. Depletion of grazing grass is evident not only on the ground, but also on the animals themselves as well as on the river waters. Conservation practices, including discouraging the keeping of too many animals, need to be introduced. These must be within the means of the small farmer, and this also involves educating him on the benefits of conservation. Soil erosion is very serious in the "Uplands" region, where slopes encourage high surface runoff. The presence of latenite (or indurated ironstone) near the surface makes the soils very susceptible to erosion and calls for adequate conservation measures on slopes where these soils are cultivated. Many of these soils have lost their A horizons.

The shifting cultivation practices are themselves now "shifting". With the increase in population, the amount of land available to a family for cultivation has decreased. This has meant that the cycle of crop-fallow-crop has had either to be reduced or eliminated altogether, with the consequence that nutrient depletion from the soils has been accelerated. This situation calls for educating the small farmer, who has to cultivated his half or one hectare year in and year out, on crop rotation and management practices that would at least maintain an adequate level of necessary plant nutrients. Artificial fertilizers should be included in this effort. The farmer on the Vertisols needs to be aware of how to maintain adequate supply of nitrogen in his soils, while the farmer on the Ferralsols and Nitosols needs to be aware of practices to maintain adequate supply of phosphorous and basic cations. Efforts in excess of that currently made by the Ministry of Agriculture Extension Services is called for.

8. SUGGESTIONS

In the previous pages we have stressed the importance of basic resource data in making land use plans and the inadequacy of the information available on resources as well as lack of adequate management practices. The exercise of generating this information is a long term job. As a first step, we would like to make some suggestions in the following pages.

We know that in many instances, economic considerations, especially when technological and economic means of the land users are advanced, have been stressed to the detriment of the physical capabilities of the land itself. Fortunately, for the vast majority of the Lake Victoria basin land users, the physical capability of the land will continue to be the more important factor for some time, especially for agricultural land utilization.

Accordingly we suggest that policy objectives of the Lake Victoria Basin Authority should recognize this and lay as much emphasis on resource conservation as on resource development. The primary goals should be (1) to improve the physical (natural) environment, and (2) to improve the socio-economic (human) environment. To achieve these goals, we suggest the following as some of the pertinent objectives:

1. An overall progressive soil survey of the entire project area at reconnaissance level. Use this information as a basis for planning development projects for both government and private enterprises. Pitfalls of the present projects (e.g. Ahero) must be recognized in future development expansion.

2. Adequate sources of water for agriculture and municipalities through development of reservoirs and existing ground water sources to reduce flooding, improve drainage, and prevent erosion. Protective measures must go hand in hand with any development projects.

3. Expand forestry program including forest inventory and reforestation.

Only objective (1) above can be considered as emanating directly from the subject discussed in this paper. However, we are aware that before this and any other objective is pursued, it will be necessary first to bring together the information on soils and all other resources that is currently available. In light of this, we wish to suggest the formation, by the Authority, of resource committees to prepare resource information reports to form the basic sources of information and data.

9. REFERENCES

1. Agricultural University Wageningen. 1974. Climate, Physiography and Land-Use of Southwestern Kenya. Report No. 1.

2. _____do_____1974. Detailed Soil Survey of the Irigonga area, Kisii. Report No. 2.

3. _____do_____1974. Detailed Soil Survey of the Marongo area, Kisii. Report No. 3.

4. _____do_____1976. A Detailed Soil Survey of the Magombo Market area, Kisii. Report No. 9.

5. _____do_____1976. Detailed Soil Survey of the Ntimaru-Angata Baragoy area. Report No. 26.

6. _____do_____1978. Water Availability for Sugar-cane in South Nyanza. Report No. 29.

7. Allan, W. 1967. The African Husbandman. Oliver & Boyd, London. P. 181.

8. Anonymous, 1975. Eastern Shore of Virginia; Resource Conservation and Development Project. USDA/SCS Richmond, Va.

9. Bartelli, L.J. (ed.) 1966. Soil Survey and Land Use Blanning. Soil. Sc. Soc. America, Wisc. U.S.A.

10. Bellis, E. (ed.) 1960. Soil Survey of the Songhor Area. Min. of Agric. Nairobi.

11. Bellis, E. (ed.) 1961. Soil Survey of the East Konyango Area. Min. of Agric. Nairobi.

12. Collins, J.C. 1954. Report on Potentialities of Tobacco Production in Certain Selected areas in Kenya. Govt. of Kenya, Nairobi.

13. D'Costa, V.P.X. and J. Makin, 1965. Bunyala pilot irrigation scheme. Kenya Soil Survey, Min. of Agric. Nairobi.

14. D'Costa, V.P.X. 1973. Kano Plains Soil Survey. Dept of Geography, University of Nairobi.

15. D'Costa, V.P.X. and Jaiswal, J. 1975. South Nyanza Sugar Project (Awendo). Govt. Report.

16. F.A.O. 1971. Drainage of the Yala Swamp. FAO, Rome.

17. Gelens, H.F., H.C.K. Kinyanjui, and R.F. van de Weg. 1976. Soils of the Kapenguria area. K.S.S. Min. of Agric. Nairobi.

18. Gibb, Sir Alexander and Partners. 1956. Kenya Nile Basin Water Resources Survey. Kenya Govt., Nairobi.

19. Kenya Soil Survey. 1978. Exploratory Soils Map of Kenya. Min. of Agric Nairobi.

20. Mbuvi, J.P. 1975. A Preliminary Report on the Suitability of the Area of Busia District for Sugar-cane Development. Site Evaluation Report No. 18. K.S.S. Min. of Agric. Nairobi.

21. Muchena, F.N. 1976. The Soil Resources of Maseno Division-Kisumu District: a preliminary investigation. Kenya Soil Survey Site Evaluation Report No. 27. Min. of Agric. Nairobi.

22. Odenyo, V.A.O. 1970. Profile Distribution of Exchangeable Bases Cation Exchange Capacity, Exchange Acidity, and Exchangeable Aluminium in Eight Red Yellow and Five Black Soils. University of Uppsala, Sweden.

23. Odenyo, V.A.O. 1978. Application of LANDSAT Data to the Studu of Land and Range Resources in the Narok Area, Kenya. Canada Centre for Remote Sensing, Ottawa.

24. Saggerson, E.P. 1952. Geology of the Kisumu District. Ministry of Natural Resources, Nairobi.

25. Siderius, W. and E.B. Njeru. 1976. Soils of the Trans Nzoia District. Site Evaluation Report No. 28. K.S.S. Nairobi.

26. Williams, L.A.J. 1969. Geological Map of the Mau Area. Ministry of Natural Resources, Nairobi.

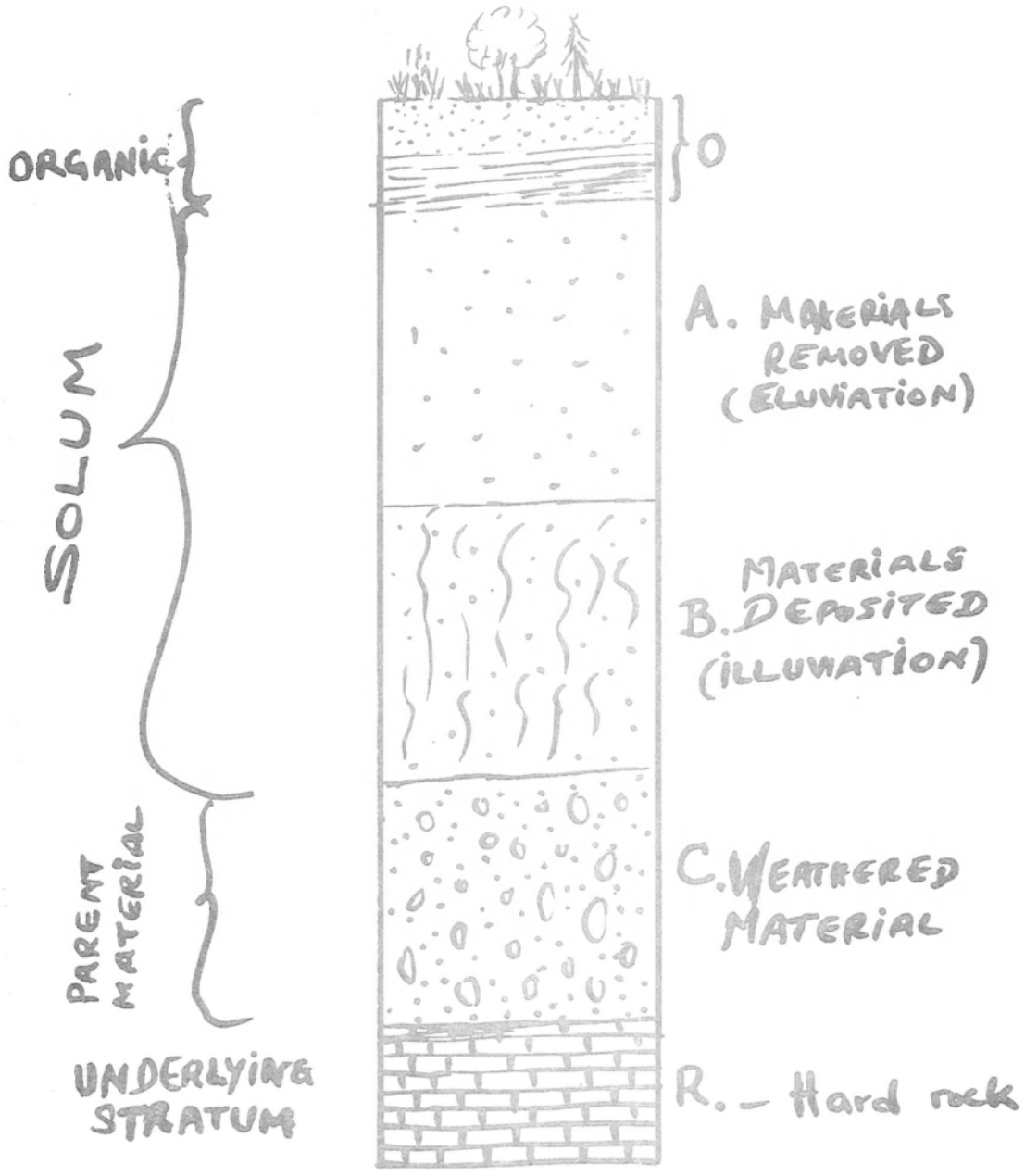
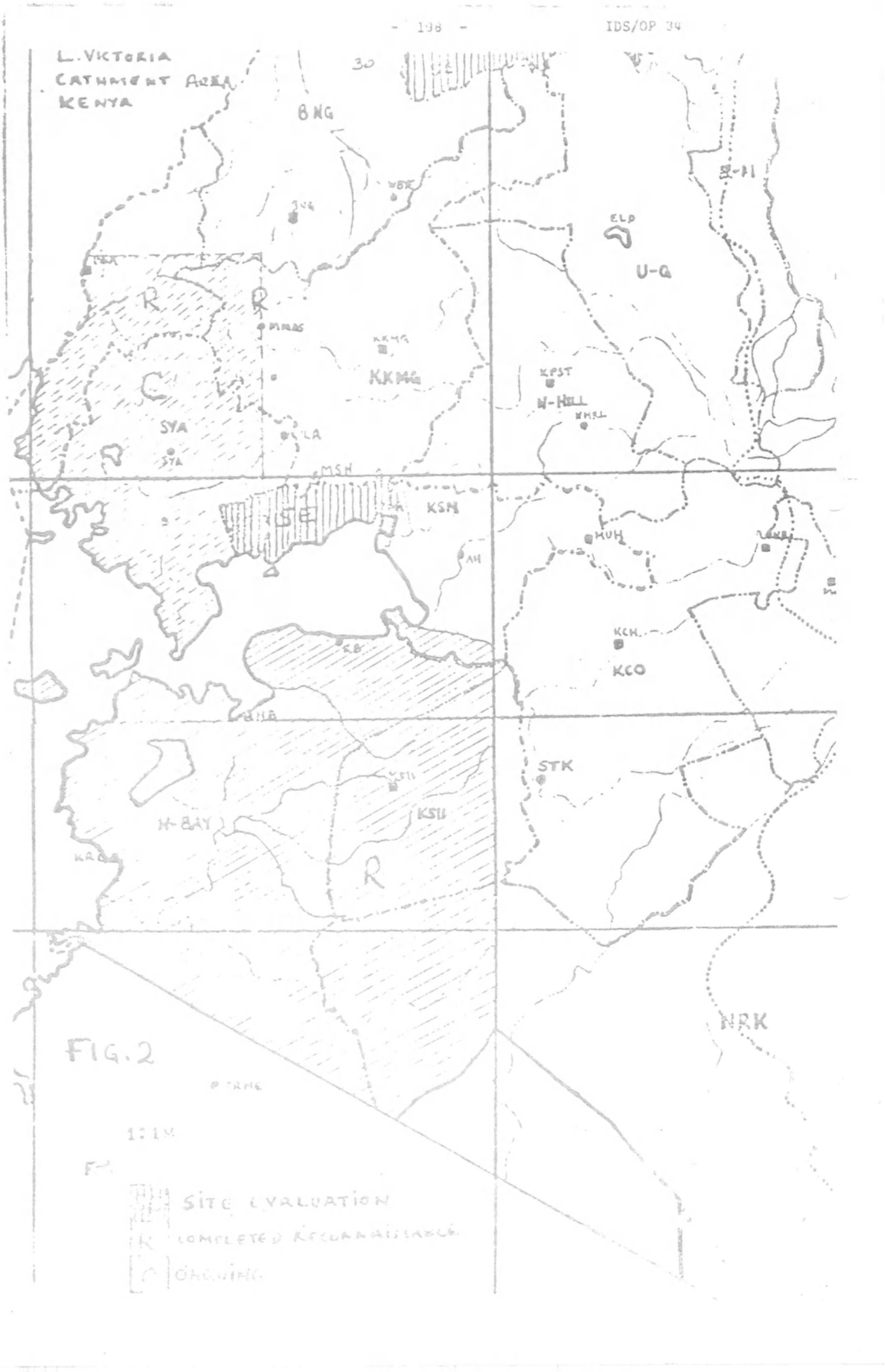


FIG. 1. A SOIL PROFILE


L. VICTORIA
CATHMENT AREA
KENYA
30
BNG
ELD
U-Q
KPST
N-HILL
KKMG
SYA
LA
MSH
KSM
AH
KCH
KCO
KSU
N-BAY
STK
NRK
FIG. 2
1:1M
SITE EVALUATION
COMPLETED RECONNAISSANCE
ONGOING

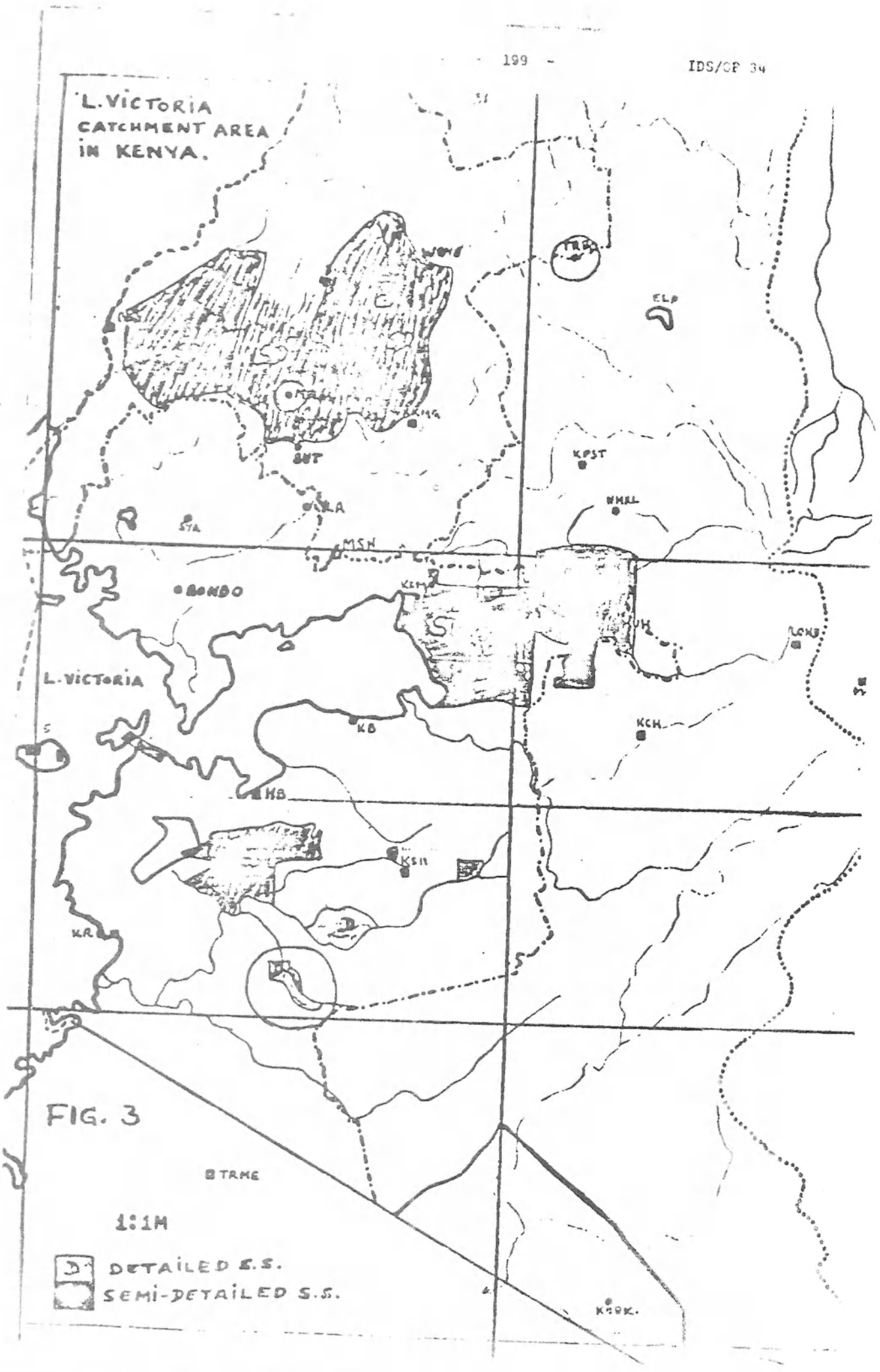

L. VICTORIA CATCHMENT AREA IN KENYA.
ELD
KPST
WHLL
MSN
KEH
UH
LOKB
BONDO
L. VICTORIA
KB
KSII
KR
KAPK.
BTRME
1:1M
DETAILED S.S.
SEMI-DETAILED S.S.

FIG. 3

THE LAKE VICTORIA BASIN : ECOLOGICAL LAND PRODUCTIVITY AS A CRITICAL POLICY ISSUE

By

Dr. Wanjiku Mwagiru
Department of Geography
University of Nairobi.

1. INTRODUCTION

Effective planning of government programmes directed towards rural development depends upon knowing the location and characteristics of the targeted areas and their target groups. In a country where 87.4% of the total population is wholly land-based, it is imperative to examine the nature of the land resource in order to identify the potentials and constraints posed to development effort.[1]

There would appear to be a strong correlation between ecological land productivity and the effectiveness of rural development programmes. This highlights the need to therefore relate policy formulation and implementation to the significant ecological variables.

This paper examines the ecological land productivity of the Lake Victoria Basin against the background of official policy that outlines the development strategy for the region. The major objective of this discussion is to analyse the relevance of such policy for the area's development, in view of the ecological and land use characteristics of the zone, and in view also of the level of rural development within the area, relative to other rural regions of Kenya.

The paper falls into three sections. Section one outlines the ecological and land use characteristics of the Lake Victoria Basin, with an emphasis on the outstanding potentials and major constraints. Section two examines the development strategy adopted for the area as reflected by official policy, and its rationality and/or relevance, while section three analyses the relative level of development of the Lake Basin region as

---

1. Mwagiru, Wanjiku 1979: Rural Environment Data for Physical and Regional Planning in Kenya. Paper presented at the Government of Kenya/ UNEP/UNDP Seminar on Natural Resource Aspects of Environmental Management Naivasha, 27th-30th November 1979.

compared to the other rural areas of Kenya. The undercurrent in this presentation is the apparent discrepancy between the very high land productivity potential and the relatively underdeveloped nature of the rural economy of the Lake Victoria Basin. The conclusion drawn is that there apparently exist some gaps in official policy either at the level of formulation of at the level of implementation, and this probably accounts for the low levels of rural development within the region in question. The critical issue that emerges therefore is whether the creation of the Lake Victoria Basin Development Authority will provide the necessary policy inputs for the effective closing of such gaps, or whether indeed its creation might not be an example of just another duplication of effort at the institutional level.

2. ECOLOGICAL LAND PRODUCTIVITY

2.1 A Comment on Land Classification

In most analyses of Kenyan development at national, regional and local levels, land issues have been identified as critical in providing a framework for decisions regarding measures aimed at raising rural productivity. Various approaches have been adopted in classifying agricultural land in general and agricultural land use systems in particular, the overriding criterion often being the level of productivity. However, other criteria have been employed in such classifications and these have tended to differ depending on the intended land use.

At the outset it can be stated that whatever approach is adopted, ultimately the primary objective should be to generate accurate and consistent data which can be used to evaluate the production possibilities of a given region, but which can also be used to assess the possible trade-offs at the official level, for the various agricultural land use systems. We outline below five systems of land potential and land use classifications that have been employed in Kenya since each of the criteria used has some relevance for the Lake Victoria Basin.

2.1.1 Land Potential Classification: This is one of the oldest and more popular approaches. Using a variety of climatic (especially average annual rainfall) and physical variables, agricultural land has been classified into three potential productivity categories viz:

a) High Potential Land with an average annual rainfall of 857.5 mm. or more

b) Medium Potential Land with an average annual rainfall of 735 - 857.5 mm.

c) Low Potential Land averaging annual rainfall of less than or equal to 6.2 mm.[2]

The basic inadequacy of this method derives from the fact that it does not indicate the particular land use systems characteristic of each land potential category. It is far too general and imprecise emphasizing potential rather than actual productivity. It is reminiscent of the 'pioneer period' of land use studies in Kenya when virtually the whole country was regarded as a 'frontier'.

2.1.2 Ecological Classification: This was basically an improvement over the above approach and was based on the more intimate interaction of moisture (potential and actual evapo-transpiration) and soils as reflected in the taxonomic (associative) characteristics of the vegetation cover. Six eco-climatic zones (I-VI) have subsequently been defined based on the recognition that moisture availability is the most potent environmental land use factor.[3] Recently, an attempt has also been made to suggest present and potential land use, but with a definite bias towards the management of this method in assessing productivity is in deriving micro data (at the farm level) particularly for the non-range wetter areas.[4]

Gross estimates of the supportive capacity of these zones indicate that Zones I and V (very high altitude mountain zone and rangeland) are suitable for extensive livestock, and have a very low potential. These zones are of very limited occurrence in the Lake Victoria Basin - the higher reaches of Mount Elgon only. Zone IV is of marginal potential only and is basically ranching country with a low capacity to support human population. This zone does not occur in the lake basin. Zones II and III are the most important agricultural areas. II has the highest potential and is especially suited to coffee, tea, pyrethrum and intensive livestock. Zone III is of medium potential and is the main mixed farming area with a wide range of cereals and other crops. It is also very suitable for livestock production. Both these zones occur extensively in the lake basin area especially Zone III.[5]

---

2. ———— 1977: Statistical Abstract. Central Bureau of Statistics.

3. Pratt, D.J., Greenway, P.J. and Gwynne, M.D. 1966: A Classification of East African Rangeland with an appendix on terminology. Journal of Applied Geology. Vol.3, 369-382.

4. Pratt, D.J. and Gwynne, M.D. (ed) 1977: Rangeland Management and Ecology in East Africa. Hodder and Stoughton.

5. Ojany, F.F. and Ogendo, R.B. 1973: Kenya: A Study in Physical and Human Geography. Longman.

2.1.3 Land Pressure Classification: This is a more recent approach that has become popularised by a number of international agencies such as the World Bank. It uses the land-population-productivity ratio in Kenya and relates population pressure to income generating land use (on-farm) activities, and therefore to the levels of income. Four such land categories have been described:

a) Low population density - high economic activity areas, and with relatively high average income levels. Within the lake region, the large farm areas are a good example.

b) Low population density - low economic activity areas, but with extremely low average income levels; typically the traditional nomadic pastoral areas, which are hardly found in the lake basin.

c) High population density - high economic activity and relatively high income levels, which are basically the smaller holder farming areas in the wetter regions. This is an important category in the Lake Victoria Basin.

d) High population density - high income activity but low average incomes. These are typically small farms in areas of low rainfall and/or poor infrastructure. This is another significant land pressure belt in the lake region especially in the low-lying areas.

2.1.4 Agro-Ecological Classification: The Integrated Rural Survey (IRS) of the Central Bureau of Statistics (CBS) has provided a broadly based data service "aimed at supplying pertinent integrated and up-to-date information on socio-economic trends" in both rural and urban areas of Kenya. The IRS sample surveys were designed to yield "the economic statistics required to investigate the performance of the smallholder agricultural sector----" and as such the data obtained during the 1974/1975 rural survey exercise[6] are of great relevance to ecological land use policy of the Lake Victoria Basin.

The IRS used a land use classification system basedoon actual and potential crop production ability of the small-holder agricultural areas in Kenya, right down to the sub-location level. Fifteen (15) were obtained on that basis and those relevant to the present discussion will be outlined later.

---

6. Government of Kenya 1977: Integrated Rural Survey 1974-1975, Basic Report. Central Bureau of Statistics.

Out of these 15 agro- ecological zones, 8 embrace 95% of the total smallholder farming population. The basic criterion for classification is the predominant cash crop for each zone.

2.1.5 Land Use Type Classification: This approach is based on the prevalence of a particular land use system, its level of activity, the type of technology employed and the spatial scale of magnitude at the farm level, It is one of the methods widely used by the Ministry of Agriculture while formulating various policies and projects for rural land use. Four land use systems have been defined:

a) Smallholder Agricultural Land use System: This is characteristic of areas in which average farm size is 5 hectares or less and of which only 3 ha. are usually cultivated. The greatest constraint that has been identified for their productivity is that they are heavily dependent on family labour while at the same time levels of technological application in land use are low. In general, this land use category can be sub-divided into three, depending on the level of technology being used viz:

i) Rainfed smallholder land use in which Traditional Technology is overwhelmingly employed.

ii) Rainfed smallholder land use in which Intermediate Technology is more evident

iii) Rainfed smallholder land use in which Advanced Technology is notably applied.

b) Extensive Land use Production System: This system is predominantly though not exclusively found in the rangelands. It includes all the existing and proposed ranches, grazing fields and pastoral land use systems. On the basis of their level of organisation and productivity, three sub-categories can be recognised:

i) Primarily Grazing Block areas that utilise traditional technology

ii) Primarily Group Ranching areas which are of a significantly higher potential and which manifest a mixture of traditional and intermediate technology.

iii) Primarily Commercial Ranching areas characterised by a high level of organisation and productivity based on advanced technology.

c) Largescale Farming System: Large farms are defined by the Ministry of Agriculture as those over 20 ha. in size. Large farm areas are still predominantly found in the former "scheduled areas" and are invariably characterised

by intensive application of advanced technology in production. Two sub-types can be isolated on the basis of farm activity:

i) Large farm mixed farming areas

ii) Plantation areas (coffee, tea, sugar)

d) Largescale Irrigation Schemes: These are found in different geographical areas notably in localised zones of the Tana and Athi River basins and in the Lake Victoria basin.

All these land use systems are found within the Lake Basin with only (b) being much less represented.

3. THE LAKE BASIN : ECOLOGICAL LAND PRODUCTIVITY

Together with the central highlands and the coastal region, the Lake Victoria Basin is one of the most productive ecological zones of Kenya. Within the immediate Lake Basin area for example, land productivity potential has been identified as mainly high or medium with only very limited areas under the low potential category as shown below.

Table 1. Categories of Agricultural Land in the Lake Basin by Province and District ('000 Ha.)

Province & District	High	Medium	Low	Total	Total Land Area
NYANZA					
Kisumu) Siaya)	432	29	-	461	461
Kisii	220	-	-	220	220
South Nyanza	566	5	-	571	571
TOTAL	1218	34		1252	1252
WESTERN					
Bungoma	253	-	-	253	308
Busia	163	-	-	163	163
Kakamega	325	-	-	325	325
TOTAL	741	-	-	741	823
RIFT VALLEY					
Kericho	380	-	-	380	489
Nandi	234	-	-	234	274
Uasin Gishu	327	-	-	327	378
Elgeyo Marakwet	104	-	92	196	273
West Pokot	103	-	365	468	507
Nakuru	291	39	231	561	702
TOTAL	1439	39	688	2166	2613

Source: I.L.O. 1978: Report of a Consulting Mission on Employment, Income Distribution, Poverty Alleviation and Basic Needs in Kenya.

Since the classification of land potential is, as has been shown, based on ecological-and eco-climatic variables, it is more meaningful at this point to examine at a more detailed level the environmental and ecological characteristics of the Lake Victoria Basin. The region has been described as providing a unique opportunity for examining the resource aspects of man- land relationships and the impact of policy changes on the uses of land. Its selection for study as a development problem- area has further been justified on the basis that it is one of the main population concentration areas in East Africa; its rural economy is primarily based on subsistence, and on incomes earned from outside it; and finally, that it is a downward transitional region with great development potential but whose level of development is below the level necessary for the population.[7;8]

This potential is reflected by an enormous diversity of the ecological and geographic characteristics, which have been attributed to the complex geological evolution of plateaus, plains and rift valleys exhibiting macro and micro-relief features. Form the perspective of ecological land productivity, this diversity can be analysed in terms of the major plant associations and their related soils, the major eco-climatic regions and lastly the principal agro- ecological zones.

3.1. Plant Associations: There are three distinct plant groupings recognisable on the basis of the dominant species viz:[9]

a) Combretum - Hyparrhenia consisting of evergreen and semi-evergreen woodland and scattered tree grassland. In the basin area this association occupies about 7,700 km^2 (3,000 sq. miles) but it has been modified by clearing, cultivation and burning. The dominant trees comprise Combretum spp. Bauhiria spp. Erythrina spp. Terminalia spp. and Vitex spp.; while the associated dominant grasses are Hyparrhenia rufa, H. Filipendula, Cymbopegon afronardus and C. Validus.

b) Grouped Tree Grassland association dominated by the red- oat grass Themeda triandra, which is characteristic of the sub- zones with impeded drainage, while in the water logged seasonal swamps Pennisetum catabasis and Andropogon spp. are more prevalent. Such poor drainage areas affect about 2590 km^2 (1000 sq. miles), while the seasonal swamps of South Nyanza occur over 1036 km^2 (400 sq. miles).

---

7. Ominde S.H. 1968: Land and Population Movements in Kenya. Heinemann.

8. Ominde, S.H. (ed.) 1971: Studies in East African Geography and Development ("The Rural Economy of Western Kenya. pp. 207-229) Heinemann.

9. Ominde, op. cit.

c) Scattered Tree Grassland with Acacia - Themeda assocation but with much less annual rainfall 508-762 mm. than (b), and of more restricted occurrence.

3.2 Ecological Zones: The Lake Victoria Basin has a well - watered lacustrine environmentabut containing a distinctive ecological contrast. On the basis of the rainfall received, there emerges a pattern that varies from about 40" in the hotter areas around the lake to over 70" in the highland areas to the east, withthe high potential land being found in the better watered areas. There are therefore two distinct ecological zones coinciding with the lowland and highland areas.[10]

a) The Lowland Region: This falls into two sub-categories:

i) The lake shore savannah and

ii) The high rainfall savannah

In general, however, this lowland ecological zone comprises a trough of low rainfall ranging from 889 - 1,143 mm, but of poor reliability in which chances of receiving 762 mm. in 19 years out of 20 are not good and only 20 - 36" can be expected. Moreover, annual potential evaporation from open water (Penman's E_o) is very high, about 2,000 to 2,200 mm. Consequently, increased land use productivity is dependent upon meeting crop needs for water during the critical growth period of the year. However, during the long rainfall season, the lowland area, especially the lake shore savannah system from flooding. There is therefore within this ecological zone the problem of alternating extremes between very dry and very wet conditions. There is also one other environmental (biotic) factor affecting the area's development, namely the periodic invasion of tsetse fly consisting of the lakeside, woodland and riverine species. This has been identified as a critical constraint that needs vigilance and attention while formulating development policies for the area.

In general, however, this ecological zone has considerable agri-cultural potential although it is on the whole inferior to the highland forest and highland grassland ecological units. It has a relatively thinner population, less arable land and a greater prevalence of poor, coarse grass that lowers its productivity and carrying capacity. But with proper planning and an input of appropriate technology, it is "capable of great development".

b) The Highland Region: This comprises the plateau block to the north and south of Kavirondo Gulf, distinctive from the lowland region on account of its higher altitude and topographic multiformity. Ecologically, this is a much

---

10. Ominde, Op.cit. p. 207-229.

better area with better watered areas that are underlain by fertile soils derived from either recent volcanics or volcanics from the pre-Cambrian period. Rainfall reliability is higher, with a likelihood of receiving over 45" in 19 years out of 20.

At one time this ecological zone was forested but long periods of human occupance have witnessed the removal of the former Vernonia-Croton forests and their replacement with Kikuyu and Star Grasses (Cynodon dactylon and Pennisetum clandestinum).

Smaller highland sub-divisions of this zone can be recognised viz: the Kisii highlands, the more elevated areas of Kakamega District and the Mt Elgon region. These areas receive annual rainfall totals of between 1270 and 1778 mm. but totals in excess of 2,032 mm are received in the Kisii highlands.

The rural economy of the Lake Victoria Basin therefore revolves around these two ecological regions. In general, it is an area with a very high ecological land potential - yet by and large.t These regions have lagged behind in economic development.[11] This has been attributed to three major reasons namely:

a) The economic policy of the colonial government that over-emphasized agricultural activity and investment in the former "scheduled areas"

b) The drain of labour from the areas directed towards the more rapidly developing economy of the highlands

c) The prevalence of traditional systems of tenure which have mitigated against the adoption of more advanced ('scientific') forms of land utilization.[12]

The foregoing sections have examined the land resource of the Lake Basin from a generally descriptive ecological approach, using the vegetation cover, moisture and biotic factors as general indicators of land potential. Of greater significance to the present discussion, however, is an analysis of the actual agro-ecological productivity of the Lake Victoria Basin.

The Integrated Rural Survey (IRS) of the smallholder rainfed agricultural areas (referred to earlier) identified 15 agro-ecological zones from Provincial, District, Location to Sub-location levels.[13] Of these, four are found within the Lake Basin. These are:-

---

11. Ominde, op. cit., p. 207-229
12. Ominde, op. cit., p. 207-229
13. Kenya 1977, op. cit.

1. Upper Cotton West of the Rift Valley, surrounding the eastern lip of the lake and extending to the sugar cane zone; then the northern and north-eastern lip, to the Bungoma coffee zone, with its extremity extending to the high altitude grassland zone of the Kitale-Eldoret arc.
2. Coffee West of the Rift comprising the Kisii block, the Kakamega block and the Bungoma block.
3. Tea West of the Rift embracing the Kericho-Kapsabet arc.
4. The Sugar - Cane Zone.

The break-down below gives the details of these agro-ecological zones by Province and District within the lake basin.

Agro-ecological Zones by Province and District within the Lake basin

	NYANZA PROVINCE
Kisii	Tea west of Rift
	Coffee west of Rift
	Sugar cane
Kisumu	Sugar cane
	Upper cotton west of Rift
	Coffee west of Rift
Siaya	Upper cotton west of Rift
	Coffee west of Rift
South Nyanza	Upper cotton west of Rift
	Coffee west of Rift
	RIFT VALLEY PROVINCE
Elgeyo Marakwet	Upper cotton west of Rift
	Coffee west of Rift
Kericho	Tea west of Rift
	Coffee west of Rift
	Sugar cane
Nandi	Tea west of Rift
	Coffee west of Rift

Nakuru	Large farm areas Large scale livestock farming
Uasin Gishu	Large farm areas
West Pokot	Large farm areas Large scale and small scale livestock farming

Source: IRS Basic Report 1977.

The most outstanding feature of the Lake Basin is, therefore, the high level of land productivity as evidenced by the diversity and range of the crops grown. As a regional entity the zone can be said to contain some of the country's highest potential for agro-ecological development, embracing different types of land use systems, and therefore, calling for a highly innovative technological base.

Yet inspite of this potential wealth of the basin, it contains some of the least developed areas within the country, and two of its leading Provinces, Nyanza and Western, rank amongst the least developed regions, on the basis of a hierarchy of provincial administrative units. The next paragraphs will examine the level of development within the Lake Basin, relative to other rural areas of the country.

4. THE LAKE BASIN: RELATIVE LEVEL OF RURAL DEVELOPMENT

The overall and ultimate objective of Kenya's development activity over the current plan period (1979-1983) has been stated as being the "Alleviation of Poverty". The pervasive nature and level of poverty nation wide has been acknowledged. In 1979 for example, 41% of rural families engaged in small-holder agriculture, which represents 80% of Kenya's total population of 14.7 million) had incomes, including subsistence production of less than Sh 2,000/- per family during 1974/1975, while only 14% of small holder families had incomes ranging between Shs 2000-3000/- per family*. These income levels are inadequate to meet rural people's requirements for basic needs which have been identified as being nutrition; health care; basic education; water and housing.[14] It is important to determine the minimum desirable standards of these basic needs in order to establish sections

---

* Sh 2,200/- per annum has been estimated as the rural poverty line while Sh 1,700/- has been estimated as the minimum desirable food consumption level.

14. ———— 1978: National Development Plan 1979-1983.

of the population and geographical areas that fall below the "poverty line" represented by these minimum standards, which brings us to the next critical point: Kenyan rural economy is notable for its regional dimensions and disparities of poverty and their geographical and socio-economic manifestations and implications[15]. For the purposes of national, regional and local planning and policy formulation, it is imperative that distinct problem areas and pockets of poverty be identified. Moreover it is important to determine the root causes of poverty in order to facilitate the identification of target groups and target areas.

It is a fact that in general and inevitably at the present levels of development, interregional variation in climatic and ecological conditions has led to regional disparities in production potential and in turn, these have become ultimately manifested by rural welfare differentials. Nevertheless it is pertinent to investigate the nature of this positive correlation between geographical/ecological location and production potential, in order to determine the strength of this relationship. To what extent does the regional manifestation of rural poverty coincide with:

a) low agro-ecological potential
b) poor infra-structure
c) underutilisation of land potential?

The composition of the basic needs bundle has been seen as being:

i. minimum income levels (from productive employment);
ii. nutritionally adequate diet;
iii. household amenities e.g. household fuel;
iv. access to government services e.g. water, health, education, roads and general infrastructure.[16]

Determination of the minimum adequate levels of this "basic needs bundle" has been ganged for various geographical, administrative and agro-ecological zones by analysing deficiency with respect to:

a) Total household consumption;
b) Food consumption;
c) Household amenities
d) Access to key government services;
e) Landlessness.

---

15. I.L.O. 1978: Employment, Income Distribution Poverty Alleviation and Basic Needs in Kenya. Report of an ILO Consulting Mission prepared by E. Crawford and E. Thorbecke.

16. I.L.O 1978: Op.cit.

Using this method of welfare indices the IRS has identified different welfare groups (with respect to poverty levels) by Province and by agro-ecological zone.

Nationwide about 571,000 households fall below the poverty levels of total household consumption and total food consumption. In other words, these households comprising about 38.5% of the total number of smallholder households have less than Sh 2,200/- for total annual consumption. On the other hand, 530,900 households or 35.8% of the total, fall below the food consumption poverty line of Sh. 1,700/-. However, it is when we consider the regional spatial incidence of poverty that the significance of regional disparities emerges. (see Figs. 1, 2, and 3 on page).

Two Provinces (Nyanza and Western), and four agro-ecological zones (Tea west of rift; Upper cotton west of rift; Taita Hills, and Coast areas with less than 40" annual rainfall) have average consumption levels that fall below the poverty line of Sh. 2,200/-. Nyanza Province alone has 214,169 households or 37.5% of its total, with inadequate household consumption, while Nyanza and Western together account for 60.5% of Kenya's total poor. Three significant zones account for 65% of the country's total poor viz: Tea, Coffee, and Upper Cotton zones west of the Rift, which have the most significant poverty problem in terms of the number of rural smallholder households affected. There is therefore, a striking correlation and spatial correspondence between the provincial and zonal patterns of poverty since both Nyanza and Western are made up mainly of the 3 agro-ecological zones.[17]

The relative degree of poverty within each province or agro-ecological zone is also a critical factor. Thus Nyanza and Western have over $\frac{1}{2}$ of their rural population in the category as compared to Central and Eastern Provinces with less than 1/3 of their population in the same category. Significantly also, the west of rift agro-ecological zones have more than $\frac{1}{2}$ of their population in the poor category (this jumps to 60.8% in the upper cotton zone) while comparatively the proportion of poor in the tea zone east of the rift and in the high altitude grassland zone drops to 10.5% and 3.9% respectively.

When landlessness is considered, the same high potential - poverty contradiction becomes apparent. Thus, the 2 poorest provinces - Nyanza and Western - have the lowest percentage of landless households, whereas the relatively richer Provinces of Central, Eastern and Rift Valley have proportionately much higher percentage of landlessness.

---

17. I.L.O. 1978: Op.cit.

In conclusion, Nyanza, Western and the Coast Provinces in that order, have numerically the most pervasive poverty problem (all welfare indices considered) with the highest percentage of their population below the poverty line. Amongst the agro-ecological zones, the most significant poverty areas are Upper Cotton, Coffee and Tea all west of the Rift.

Yet these administrative units and their component agro-ecological units are amongst the most potentially productive areas in Kenya, and consequently therefore "..... poverty is not found only in areas of low agricultural potential since the 3 worst zones are all high or medium potential areas".[18]

In the light of the foregoing, one is therefore forced to conclude that since the Lake Basin is not of low agro-ecological potential, the two other factors that must be analysed in an attempt to explain the underdevelopment of the region are poor infra-structure and underutilisation of the land potential. Other factors that could also be responsible are low access to government sponsored services, and lack of off-farm income-earning opportunities. That being the case, an evaluation of official policy and its relevance to effective development in the basin is called for, since the extent of rural poverty illustrates the political and socio-economic constrai s on policy making for the region.

4. FORMAL POLICY FOR LAKE BASIN DEVELOPMENT

The 1979/1983 Development Plan broadly states that planning for rural agricultural development will proceed on the basis of regional analysis considering watershed and agro-climatic areas, but implementation will be on a district basis in order to ensure local rural participation in the asses ment of needs and priorities.

In its broad strategy for the "alleviation of poverty" the Plan identifies 4 major thrusts:-

a) Creation of income-earning opportunities.
b) Improvement of expenditure patterns
c) Provision of other basic needs
d) Institution building.

At a more specific level of rural development objectives have been spelt out thus:

---

18. I.L.O. 1978: Op.cit.

a) Ensure better land use.
b) Provice essential services, credit extension inputs, markets and transport to small farmers.
c) Construct rural access roads to expand flow of farm inputs, extension services and credit, market accessibility, water and power.
d) Identify and encourage inexpensive appropriate technologies for the enhancement of small-farm productivity.

Alongside these are small farm development programmes and projects which are regarded to a "key element of the Plan". Through them, alleviation of poverty will purpotedly be achieved by the mobilization of small-farm resources for food and cash crop production, while a number of special crop sub-projects are already in the implementation stage. In all this the key "package deal" is seen as the innovative component viz: developing technologies for small-farm and non-farm activities for the modification of the "jembe" model.

Concurrent with the macro or national policy for rural development is the basically similar policy for special projects and special areas, the classical example being the Integrated Agricultural Development Programme (IADP). This has been officially referred to as a "new programme" which gives priority to the needs of less privileged small farmers, a target group which to date, it has been said, has been largely excluded from the development process. It is envisaged that the IADP would widen the social impact of rural development as well as the production base and thereby strengthen the economy, by bringing about a more equitable distribution of development to the rural districts.

The centre piece of the IADP consists of firstly the promotion of a whole farm approach rather than the single corp single activity approach and secondly, the encouragement of the development of project planning and implementation responsibilities at the local (administrative district) level: an overall orientation change from the "vertical" to the "horizontal" development approach.[19]

Both Nyanza and Western Provinces are covered by the IADP with an affected area of 536,000 ha. (20,749 km^2) within which are 136,000 holdings and 181,000 families. The total west of the rift project area comprises 10.1% of the country's total land area and 60% of the total population. The participating districts are Kakamega, Siaya, Kisumu, Kisii and South Nyanza.

---

19. World Bank 1976: Kenya: Appraisal of the Integrated Agricultural Development Programme.

Having now identified the different levels of formal policy as they affect
Having now identified the different levels of formal policy
as they affect the Lake Basin, it is pertinent to examine how the Lake Basin Development Authority fits into the existing policy framework for the purposes of realistic and meaningful development in the area.

It has been suggested that some of the functions of a Lake Development Authority might include among others:

1. Long term sound planning
2. Implementation and coordination of government sponsored programmes without radically deviating from the already spelt out strategy
3. By the nature of the delineation of the area, the LBDA should concentrate on water, agriculture, livestock, conservation, forestry, fishing and hydropower.
4. Advise to, and consultation with, Government on all matters affecting the development of the area including the apportionment of water --- and so on.

An important question at this juncture is related to the role of the LBDA as an institution, operating within the lake basin,alongside the other institutions. In order for it to be fully functional in contributing towards the development of the area, and in order for it to complement the activities of the other operative agencies, it is imperative that existing gaps in formal policy for the area's development be identified.

The term development strategy can be briefly described as measures affecting major socio-economic, political and environmental variables, and which is based on some concept or philosophy of the desired productive socio-economic system over a defined period of time. The specific development strategy ".... deals with large issues, sees economic policy as a **whole**, gives the decision-makers a sense of direction and provides a set of general principles upon which to base specific policy measures"[20] In other words, it is the total embodiment of the development process as conceptualised.

This is the framework within which the LBDA should be viewed, and its possible roles and functions analysed. However, the ultimate denominator in this process is the land; its ecological and agro-ecological productivity, and the land use systems through which this productivity is manifested, and upon which the achievement of the stated goals in development depends.

---

20. House and Killick T. 1979: Future Development Possibilities for Kenya and their Energy needs. Paper presented at the International SWorkshop on Energy and Environment in East Africa. The Royal Swedish Academy of Science. 7 - 11 May.

CONCLUSION

This paper has attempted to raise certain issues related to the policy dimension of land productivity and land use in the Lake Victoria Basin. Its major thesis has been, that despite the enormous potential for rural development within the region, the area is nevertheless one of the least developed in the country, whatever indices one chooses to measure development. It is suggested that it is within the context of this reality that the creation of the LBDA should be evaluated.

The major contribution of the LBDA should be seen as the launching of the affected zones way ahead of the land utilisation activities currently in progress. For this to be realised, critical gaps in existing policies, projects and project implementation must be identified and studied at a greater in-depth level.

REFERENCES

1. Mwagiru, Wanjiku 1979: Rural Environment Data for Physical and Regional Planning in Kenya. Paper presented at the Government of Kenya/UNEP/UNDP Seminar on Natural Resources Aspects of Environmental Management. Naivasha, 27th - 30th November 1979.

2. ———— 1977: Statistical Abstract, Central Bureau of Statistics.

3. Pratt, D.J., Greenway, P.J., and Gwynne, M.D. 1966: A Classification of East African Rangeland with an Appendix on Terminology. Journal of Applied Ecology Vol.3, p. 369-382.

4. Pratt, D.J. and Gwynne, M.D. (ed.) 1977: Rangeland Management and Ecology in East Africa. Hodder & Stoughton.

5. Ojany, F.F. and Ogendo, R.B. 1973: Kenya: A Study in Physical and Human Geography. Longman.

6. Government of Kenya 1977: Integrated Rural Survey 1974-1975, Basic Report. Central Bureau of Statistics.

7. Ominde, S.H. 1968: Land and Population Movements in Kenya. Heinemann.

8. Ominde, S.H. (ed.) 1971: Studies in East African Geography and Development (The Rural Economy of Western Kenya. p. 207-229). Heinemann.

9. Ominde, op.cit.

10. Ominde, op.cit., p. 207-229

11. Ominde, op.cit., p. 207-229.

12. Ominde, op.cit., p. 207-229.

13. ———— 1977: Statistical Abstract Central Bureau of Statistics.

14. ———— 1978: National Development Plan 1979-1983.

15. I.L.O. 1978: Employment, Income Distribution Poverty Alleviation and Basic Needs in Kenya. Report of an ILO Consulting Mission prepared by E. Crawford and E. Thorbecke.

16. I.L.O. 1978 : op.cit.

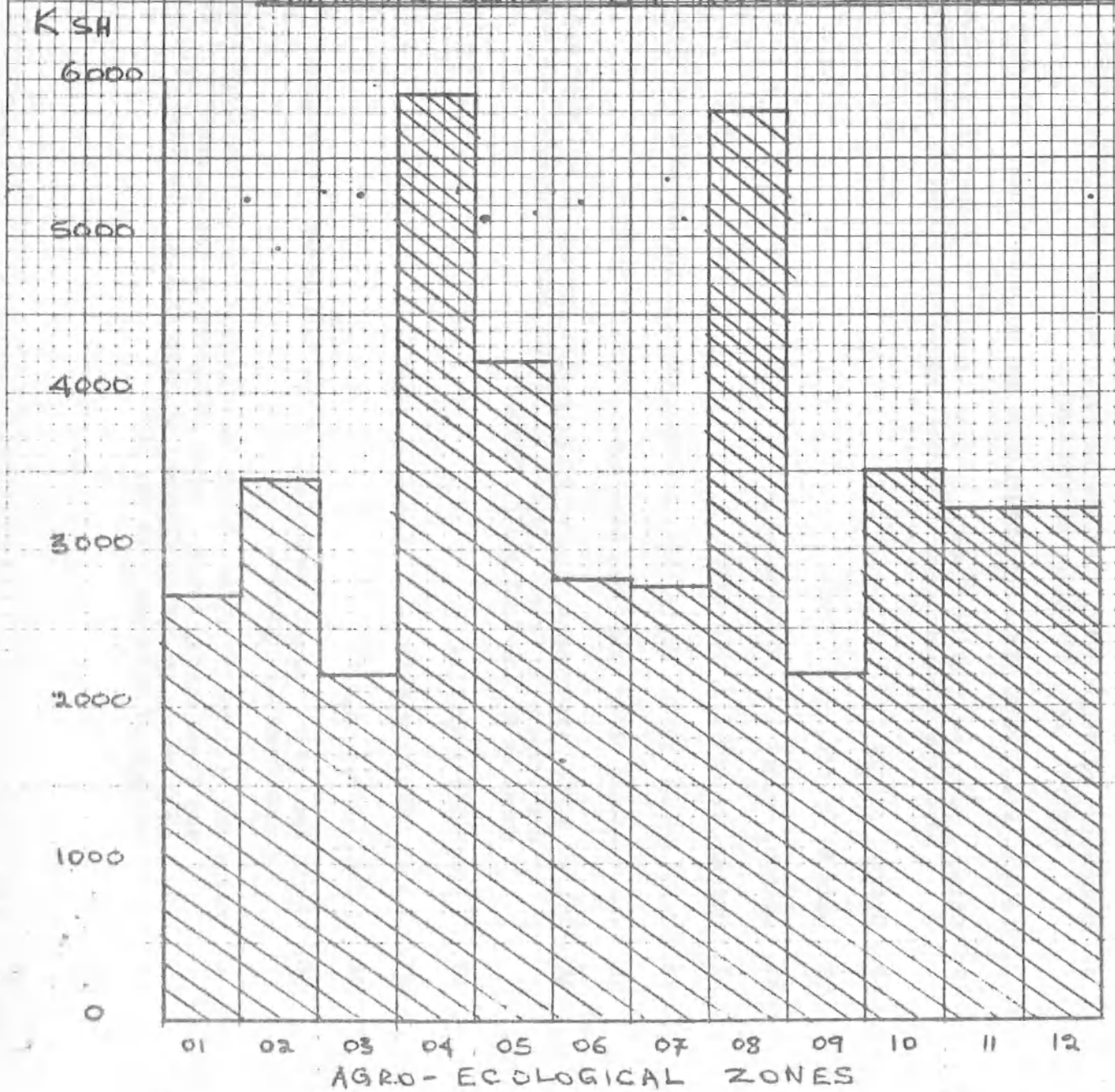
17. I.L.O. 1978 : op.cit.

18. I.L.O. 1978 : op.cit.

19. World Bank 1976: Kenya: Appraisal of the Integrated Agricultural Development Programme.

20. House and Killick, T. 1979: Future Development Possibilities for Kenya and their Energy Needs. Paper presented at the International Workshop on Energy and Environment in East Africa. The Royal Swedish Academy of Sciences 7-11 May 1979.

FIG 1 CHARACTERISTICS OF MEAN TOTAL HOUSEHOLD CONSUMPTION FOR SMALLHOLDERS BY AGRO-ECOLOGICAL ZONES

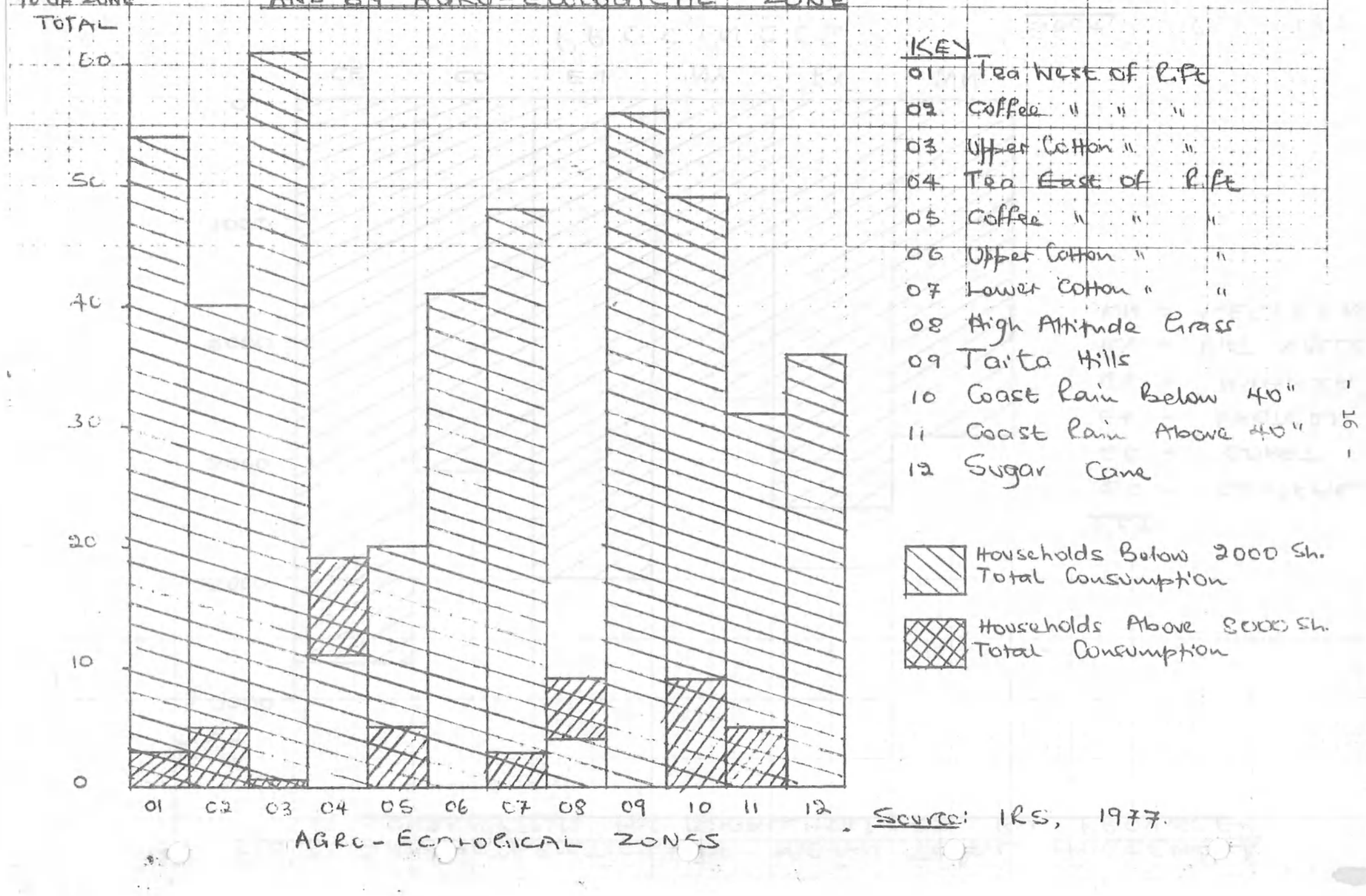


KEY

01 Tea West of Rift
02 Coffee " " "
03 Upper Cotton " "
04 Tea East of Rift
05 Coffee " " "
06 Upper Cotton " "
07 Lower Cotton " "
08 High Altitude Grass
09 Taita Hills
10 Coast Rain less than 40"
11 Coast Rain Over 40"
12 Sugar Cane

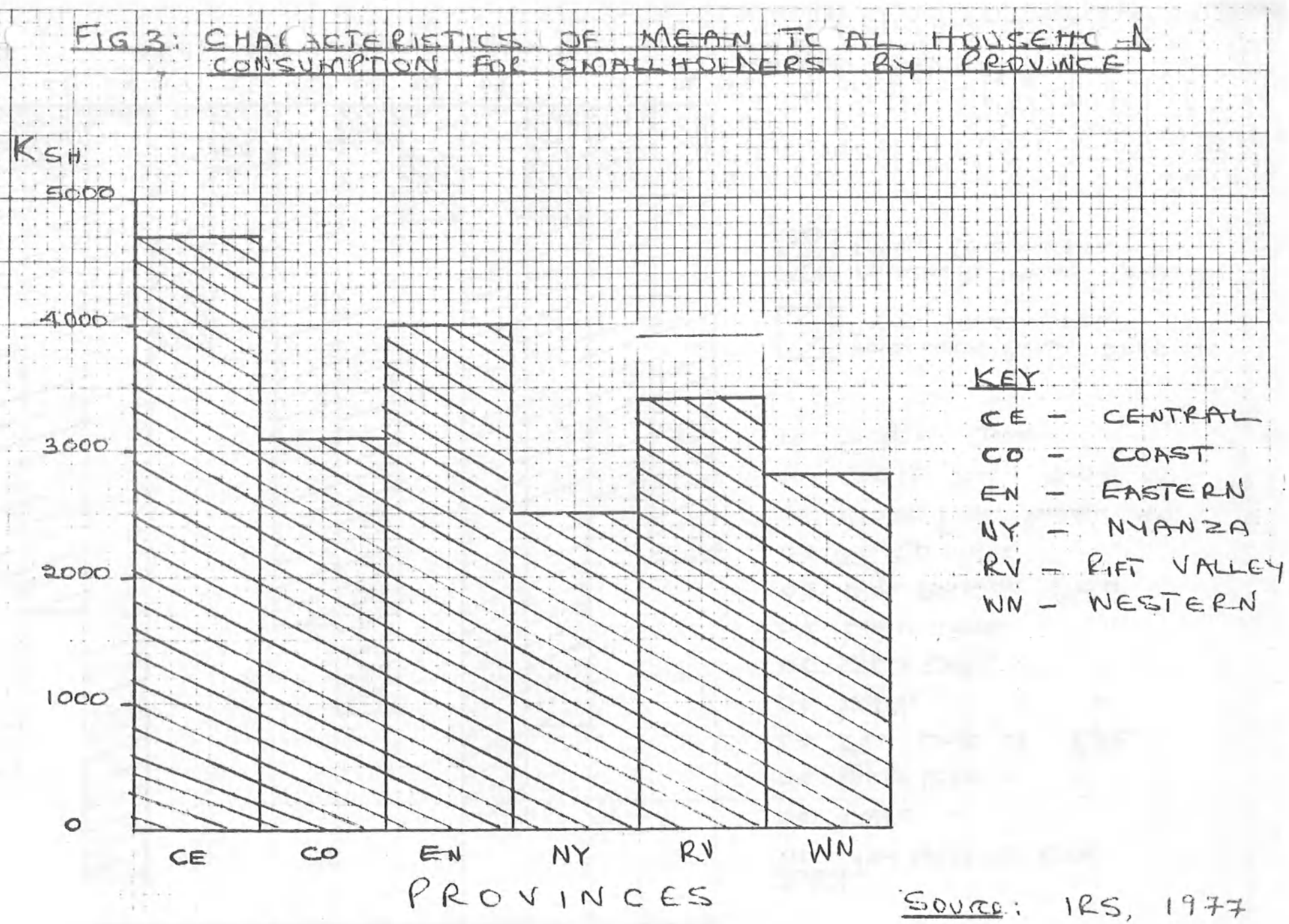
Source: IRS, 1977

FIG 2: SMALLHOLDER HOUSEHOLDS BY TOTAL CONSUMPTION AND BY AGRO-ECOLOGICAL ZONE



Source: IRS, 1977.

FIG 3: CHARACTERISTICS OF MEAN TOTAL HOUSEHOLD CONSUMPTION FOR SMALLHOLDERS BY PROVINCE



SOURCE: IRS, 1977

AGRONOMIC LAND USE STRATEGIES FOR THE LAKE VICTORIA BASIN

By

Dr. J.O. Ogot
B.A.T. Kenya Development
Nairobi.

1. INTRODUCTION

The land within the greater area to be covered by the Lake Basin Development Authority is occupied in a variety of ways by both the living and non-living things. But what do we mean by land use as opposed to land occupation? While all other animals occupy the land and live on the existing herbage without consciously altering its composition, it is probably only man who consciously makes use of the land by manipulating the environment to his own ends and satisfaction. In the Lake Basin, as elsewhere, we find that the land is used in a variety of ways including mining of all types, afforestation both natural and planted, agricultural production both - rainfed and irrigated and some land is used as national parks and game reserves. Human settlements and communication infrastructure also make use of some land, which therefore, is not available for agriculture.

In this discussion, we shall only consider the land use systems for Agricultural production. The land use systems to be found in the Lake Victoria Basin for Agricultural production include the following:-

1.1 Rainfed small holder agriculture.

1.2 Large-Scale farming including mixed farms as well as low density settlement schemes such as those found in the sugar belt.

1.3 Large-Scale irrigation schemes. The individual farmers within the schemes may be considered small holders.

1.4 Livestock production under ranching systems. These could be for both milk and meat production.

Small holder system of Agricultural production is predominant in the region, due to the small farm size. On these small pieces of land mixed farming is generally practiced. It has been observed that under these circumstances the aim must be to intensify land use so as to generate enough incomes and employment for the farmers and their families. Most of the land within the Basin is however fertile and quite suitable for Agricultural production.

2. THE PRESENT/TRADITIONAL PRACTICE:

2.1 The dry areas: Basically there are two types of agricultural practices to be found in the Lake Victoria Basin; namely rainfed and irrigated agricultural land use. It is fair to observe that those areas that receive adequate rainfall (between 40-60 inches of rain per annum) are more developed agriculturally than those areas with less than adequate rainfall.(less than 35 inches of rainfall per annum). Such dry areas still suffer from the alternate effects of drought in the dry season and flooding during the rainy season. These areas also tend to be over-stocked with livestock and therefore the problems of over-grazing and soil erosion are serious. Where proper irrigation has been developed, the agricultural productivity has been improved and the cash earning capacity of the farmer substantially increased. The problems of flooding have also been controlled or virtually eliminated in these areas. The Ahero Rice Scheme is a good example of such a project.

The livestock kept in these areas is generally low yielding indigenous types which is well adjusted to the harsh conditions of high disease risks, poor grazing with little water supply and generally lower standards of management. They include the indigenous Zebu cattle, African fat tail sheep and an assortment of indigenous goats and chickens. For the people living in these areas, the livestock form an important source of food i.e. proteins and is also traded for the cash needed in their daily living. It is also not uncommon to use oxen as the source of ploughing power.

2.2 The high rainfall areas: In the adequate rainfall areas on the other hand the trend is towards cash agriculture. Here the growing of cash or industrial crops such as tea, coffee, pyrethrum and sunflower in the higher attitude ground is common. In the sugar belt sugar cane dominates. Maize, bananas, pineapples, and a variety of fruits and pulses as well as other crops are also found. Both planted and natural forests are also to be found in these areas. Such areas include most of Kisii District, Nyabondo plateau, Maseno Division, parts of Western Province, the Sugar Belt in the foot of Nandi Hills, South Nyanza and Western Province including the catchment areas of Kericho and Nandi Districts. The livestock kept in these areas are fewer and higher yielding. These include improved dairy type cattle, some wool sheep and improved types of poultry. As the farm size tend to be smaller in these areas the land utilization for agricultural production is more intensive. The use of fertilizers to increase productivity from the land

is viewed as essential in these areas. The income generated by the farmers per unit of land is therefore expected to be higher in these areas than is the case in the drier areas where irrigation methods are not used.

3. THE POTENTIAL LAND USE.

It has been mentioned elsewhere in this paper that the soils within the Lake Victoria Basin are fertile and quite suitable for agricultural production. It is suggested that the limiting factors to higher agricultural productivity include the following:-

3.1 Lack of adequate rainfall in the lower or drier areas of the basin. Proper irrigation methods can therefore be expected to increase the potenti of soils in these areas for agricultural production. These will also help to control flooding which also hinders proper land use for agricultural purposes.

3.2 Poor cultural practices. The traditional system whereby every farmer or land owner tries to produce everything that he needs for subsistence generally results in poor yield and low out put. This is because some crops or production systems are not suited to certain areas. Specialisation and the use of improved agricultural techniques would improve productivity of t soils. Cotton yields, for example, are generally low in cotton areas because the crops is usually planted late after the food crops or in some cases as a second crop. The use of fertilizers and other necessary inputs is inadequate.

3.3 Lack of organised marketing. Some production systems have experienced slow or lack of growth due to poor or non-existent marketing opportunities. Soyabeans and commercial poultry production are good examples here. There is great potential for these commodities in the Lake Basin if their marketing is organised. Such marketing should strive to reduce the role of the middleman.

3.4 Lack of effective extension service. To improve agricultural productivity, it is essential to increase the awareness on the part of the farmers with regards to the potentials of their particular lands and on the technological requirements for the production systems, of their choice. Such technological requirements should include the types and quantities of inputs, time limits and proper cultural or management practices to be followed. The farmers also need to be educated on the benefits of using improved varieties.

3.5 Taboos and beliefs. These will determine whether or not a production system will be accepted and practiced, regardless of the potential of that system. Tobacco growing has been rejected in some parts of South Nyanza, quite suitable for its growth, because of religions beliefs. Poultry production has also been looked upon in some areas as a job for the women and nothing to be taken seriously by the men-folk.

3.6 The lack of inputs. Because of the low individual incomes of the people living in several parts of the Lake Basin, their ability to use adequate levels of the needed inputs is limited. The result of this is that the full potentials of the soil for agricultural production cannot be achieved.

Although, the above list does not include all the factors that limit the achievement of the full potential of the land in the Lake Victoria Basin for agricultural development, it gives a summary of some of the important ones. However, it is true to say that the potential of the land within the Lake Basin is high and to exploit this potential, the Lake Basin Development Authority and any other bodies involved in its agricultural development will need to develop strategies which will remove as many of the above limiting factors as possible. The need for proper planning in these land use strategies cannot be over - emphasized.

4. RECOMMENDATIONS ON LAND USE

Other contributors have made policy recommendations on land use for the Lake Victoria Basin and an attempt will be made to avoid repeating these. The discussion here will be confirmed to specific comments on the various production systems to be found within the Lake Basin. In broad terms, however, it can be said that increased agricultural productivity of the land in the Lake Victoria Basin will to a large extent depend on the success in removing the limitations discussed elsewhere in this paper.

4.1 Crop Production: The crops produced in the Lake Basin area include both cash crops, those grown largely for their commercial value, as well as food crops grown for subsistence or home consumption.

It must be pointed out however, that there are several crops which are grown for both their commercial value i.e. as cash crops and also for their food value to the local population. If not enough of such crops are produced famine or malnutrition could occur as the little harvests are sold for cash leaving very little or nothing for food.

4.1.1 Food Crops: Maize. As a staple food for the majority of people living in this area, maize is by far the most important food crop. A lot of research has been conducted nationally on this crop to develop new varieties suitable for different ecological areas of the country. New hybrid varieties suitable for the different areas within the Lake Basin are now available. For maximum yields, these varieties must be grown following the recommended cultural practices.

Better storage methods and facilities will, however, need to be developed to reduce losses. Poor marketing arrangements especially for the small scale farmers tend to slow down or hinder the expanded and improved production of this crop.

4.1.2 Other Food Crops: Cereals. Sorghums, millet, and rice are the common cereal food crops grown in the region to supplement or replace maize. Relatively less scientific information has been accumulated on these crops especially sorghums and millets. Sorghums are known to do better in areas with less rainfall than is required for maize production. Variety selection and improved cultural practices will be needed for improved yields of these cereals.

Cassava: A very good source of carbohydrates for human feeding. Generally used in combination with or as an alternative to cereals in the diet.

Cassava can also have commercial or industrial importance in the manufacture of starch.

Cultural methods need to be improved to increase yields.

Sweat Potatoes: Production of this crop should be increased through the use of better yielding varieties and organised marketing system. Its use as a supplementary feed for livestock will help to increase its usefulness and expand its marketability. In this connection those varieties with a high folliage cover are prefered. The folliage (vines) is very useful as fodder for ruminant animals, while the tubers can be used by both animals and as human food.

Potatoes: (Irish Potatoes) The introduction of this crop as an alternative food source in the Lake Basin should be investigated. Negligible amounts are produced in a few areas. A very popular and good source of carbohydrates for human feeding.

Groundnuts (Peanuts) Is a very popular food crop in the Lake Basin especially in South Nyanza District. Also used as an industrial crop in the production of edible oil. The by-products of the oil extraction process i.e. groundnuts cakes are also useful source of protein for live-stock feeding.

Better varieties and improved cultural methods in growing and harvesting the crop need to be developed. The marketing channels of the crop are now inadequate and not properly organised. This has the tendency to de-stabilise the prices and encourage hoarding.

4.1.3 Irrigated Food Crops: Rice is by far the most important food crop grown commercially under irrigation. More research to develop disease resistant high yielding varieties will continue to be necessary. The expansion of irrigation programmes such as those at Ahero in Kano plains and those in Samia will encourage the use of land which is otherwise lying idle and increase land productivity in the Lake Basin. Irrigation schemes also help control the flow of rivers which normally cause flooding and hinder agricultural productivity in the Lake Basin.

4.1.4 Fodder Crops: Positive steps must be taken to encourage the establishment and production of fodder crops such as improved pastures containing a mixture of grasses and legumes, the growing of napier and bana grasses, potato vines and other suitable fodders. This will help improve the efficiency of livestock production especially on the small scale farms. In the absence of such crops the productivity of the available livestock especially ruminants becomes very low particularly during the dry season. Over-grazing of the available pastures therefore follows accompanied with soil erosion problems when the rains arrive.

4.1.5. Fruit Crops: There is a great potential for fruit crop production of all types including citrus fruits and others. The creation of commercially viable orchards should be encouraged. Crops like bananas, pineapples and passion fruit do well in certain zones of the Lake Basin. Organized marketing especially for bananas will need to be developed. Some processing and or packaging of these products locally will greatly improve their usefulness as cash earners.

4.1.6 Horticultural Crops: Various vegetables as well as flowers can successfully be produced. Green vegetables which are commonly consumed within the basin can also provide cash for the farmers. Some of these crops now find their way into the bigger market areas such as Nairobi. A more active

involvement of the National Horticultural Co-operative Union in the development and marketing of various crops will definitely help increase production of Horticultural crops within the Lake Basin especially since the average farm size is relatively small.

4.1.7 Cash Crops: Sugar cane is by far the most important cash crop in several parts of the Lake Basin. More crashing capacity will be needed to cope with the already increased output or over-production.

A sugar cane production policy to control its growing and avoid continued over-production is urgently needed. There is also the fear that with the rush by farmers to grow sugar cane the area is likely to face a shortage of essential food crops which people need for their nourishment.

Tea, Coffee and Pyrethrum: These are grown in the higher altitude ground within the Lake Basin. The production and marketing of these crops are strictly controlled and regulated by the appropriate statutory Boards i.e. Kenya Tea Development Authority (K.T.D.A.) for tea, Coffee Board of Kenya for coffee and Pyrethrum Board for pyrethrum. Coffee which has a bigger scope for expanded production has not been properly managed and therefore the yields are generally low as compared to those achieved in other coffee growing areas in the country. Major coffee expansion programmes run by the Ministry of Agriculture are under way. These will need to be accompanied by aggressive and effective extension to ensure success.

Tobacco: Under the auspices of B.A.T. Kenya Limited this crop is produced in parts of South Nyanza and Bungoma Districts and there is scope for the expansion of its growing within these and other suitable locations within the basin. A vigorous campaign for afforestation will be necessary with the continued and increased production of this crop. It is estimated that for each acre of tobacco grown, about 10 acres of forest (trees) are needed to cure it. B.A.T. Kenya Limited has tree nurseries for the supply of seedlings for this purpose.

4.1.8 Oil Seeds: Groundnuts have been discussed elsewhere in this paper. Cotton seeds, simsim and sunflower are also produced in the Lake Basin. Their marketing and production including the use of improved varieties will need improving. Soyabeans are another oil producing crop to be considered for this area. Like with the other oil seeds, both the seeds and by-products of oil extraction are useful as protein foods for livestock. Its establishment and processing would therefore have a positive influence on the development of livestock production in the area. Preliminary tests have indicated

that the crop can do well in parts of South Nyanza and Kisii Districts. The possibilities of having an oil extracting set-up within the Basin should be investigated.

4.1.9 Cotton: This crop is well suited to the Lake Basin environment and high yields of good quality fibre is achievable. The problem which manifests itself through low yields has been due to poor cultural practices. The planting time is usually wrong as the farmers tend to plant cotton too late i.e. after planting their food crops.

Improved varieties are available and the necessary cultural practices are known. It will need aggressive and effective extension to adopt these practices if yields have to be substantially improved and full potentials realised.

4.2. LIVESTOCK PRODUCTION

4.2.1 Cattle: The Lake Basin has a potential for both Dairy and Beef cattle production. While Dairy cattle do better in the higher rainfall areas or with supplementary feeding, beef cattle will thrive well in the drier parts of the basin where farm size is generally large or in ranches and feed-lots. A feedlot project based on Bagas (Sugar cane waste), molasses and maize or sorghum silages would be viable especially in the sugar belt. This would utilize sugar cane by-products which are now wasted.

Improved tick borne disease control through the use of dips and improved management practices will ensure the establishment of commercial dairy units which are needed in the Lake Basin. Most of the milk in this area is now produced by the beef-type animals which is an inefficient and expensive way to produce milk.

Improved breeds should be introduced and maintained for increased dairy and beef production. The use of Artificial Insemination (A.I.) should be encouraged even among the indigenous cattle to upgrade them and increase their productivity. The management skills of the farmers will need to be improved through short courses at farmers training centres and via extension service.

4.2.2 Sheep and Goats: A sheep and goats improvement project has been proposed for Samia area in the Western Province. Similar projects should be considered for the low land areas of Nyanza Province and other parts forming the Lake Basin. The aim of such projects should be the introduction of improved breeds to upgrade the indigenous ones so as to increase their

production in terms of meat yield. There maybe a case for the introduction of milk goats in the Lake Basin to increase the availability of animal proteins in the diet of the local people.

4.2.3 Poultry: The Lake Basin has a large population of indigenous chickens but very few improved types. An integrated poultry project including breeding stock, hatching (hatchery), broiler production and processing as well as egg production and marketing should be initiated. This project should include feed manufacture and distribution. A marketing organization to ensure the maintenance of standards for all poultry products should also be organised to streamline operations suggested above.

The need to use improved poultry varieties and management practices cannot be over-emphasized. Better and effective extension as well as disease control strategies need to be developed. Vaccinations against diseases like New Castle should be made mandatory for all poultry in the area. The introduction of new poultry into the area would also be strictly controlled.

4.2.4 Bee Keeping: The production should be increased with the view to exploiting the full potential of this activity. The small honey concentration factory based at Sondu in Kisumu District should be expanded and developed to process wax and other products of Bee Keeping.

Extension courses to educate farmers on the proper methods of Bee-Keeping will be necessary. A very suitable farming activity especially where the land is small and not very fertile. Could encourage the development of flower industry.

5. AGRO INDUSTRIES

Agriculturally based industries need to be discussed together with the above land use recommendations. The establishment of industries associated with food processing and packaging need to be considered in association with the projects proposed above. This would ensure the retention of a high percentage of the cash returns from these projects for the benefit of the local-farmers. It would also increase job opportunities for the population within the Lake Basin. The manufacture and distribution of small farm equipments and tools could also help to provide valuable job opportunities within the region.

In conclusion it is observed that the potentials of the lands in the Lake Victoria Basin for agricultural production are very high. The achievement of the exploitation of the full potential of these lands will, however, depend on the availability of resource inputs and the willingness on the part of the farmers to adopt the new required technologies in farming and adjust their traditional ways accordingly. The future looks bright but the need to save time is a real one. In this connection proper planning where priorities are sensibly developed would be essential. This is where a body like the proposed Lake Basin Development Authority can play a vital role in planning and regulating agricultural development in the area of its jurisdiction.

IDS/OP 34

THE ROLE OF THE SUGAR INDUSTRY IN THE KENYAN ECONOMY: A CASE STUDY OF THE LAKE VICTORIA BASIN

By

J.E.O. Odada
Department of Economics
University of Nairobi.

1.1 INTRODUCTION

Kenya's agricultural sector still provides livelihood to over 80 per cent of the country's total population. Earlier views that rapid industrialization would soon transform the structure of Kenya's economy by providing alternative (non-farm) employment and therefore reducing the proportion of total work force dependent on agriculture for employment and incomes have been proven wrong by the events of the last fifteen years.

Kenya has been experiencing a high rate of growth of industrial output but this has been accompanied by an even higher rate of growth of average labour productivity in the industrial sector, implying that Kenya's industrial employment has been lagging significantly behind industrial output growth (14). Consequently, the proportion of the country's total labour force dependent on agriculture for employment and incomes has been increasing instead of decreasing.

Considerable research interest has been drawn into trying to determine the causes as well as sources of the observed lag in industrial employment. Though there have been apparent contradictions in empirical findings, the general conclusions of the researches point out to the fact that relative factor pricing and industries with substantial substitution possibilities on the one hand (19:31), and investment expansion embodying modern capital-intensive technologies with limited factor substitutability on the other hand (26:27), both contribute to the observed lag in industrial employment behind industrial production growth at the aggregate level.

It is therefore only too clear that Kenya has to rely on agriculture for quite some time as the main source of livelihood to her fast-growing population. However, by the sheer size of agriculture in a predominantly agrarian economy like Kenya's with a large labour force relative to the available agricultural resources, marginal productivity of labour is bound to decline with growth in agricultural labour force thereby creating

a ceiling on the extent to which the sector can provide gainful employment. What is required is increased productivity in agriculture so as to expand its capacity to provide gainful employment. This could be done by emphasising the production of high-valued cash crops whose production processes require high levels of labour participation. Sugar cane is one of the crops traditionally looked at in this sense. It is believed to be a high-valued cash crop which is capable of providing gainful wage employment and self employment to a large proportion of Kenya's total agricultural work force. Besides, increased production of sugar cane would save the country the needed foreign exchange which is currently being spent on sugar imports. This paper examines the extent to which sugar cane production contributes to income generation in the Lake Victoria Basin and the potential of the industry to provide gainful wage employment and self employment.

High-valued cash crops can provide gainful employment in agriculture only if the underlying technologies in their production processes require high levels of labour participation. Therefore, as a first step in an attempt to identify the crops to be emphasized, we need to know the characteristics of the underlying technologies in various agricultural industries.

One important characteristic of an underlying technology is its flexibility with respect to ease of substitution between factors of production. This important characteristic known as the "Elasticity of Factor Substitution" relates proportional changes in relative factor use to proportional changes in relative factor prices. If we write σ for the elasticity of substitution between capital and labour, K for capital input, L for labour input, W for the farm wage rate and I for the real cost of capital, respectively, then:

$$\sigma = \frac{d\ln\left(\frac{K}{L}\right)}{d\ln\left(\frac{W}{I}\right)} \qquad (1).$$

Defined by equation (1), elasticity of substitution =

Kenya still imports large quantities of sugar to bridge the gap between domestic consumption and domestic production and the country's long-term objective is to become self-sufficient in sugar production with a possibility of producing surpluses for export. Expansion of sugar cane production must, however, be based on an ability to identify the low-cost producers in the industry and a thorough understanding of the existing economies or diseconomies of scale to enable the agricultural policy-makers to encourage that scale of farm operation that will provide the desired sugar cane output at the minimum possible average cost. It must also be based on a thorough understanding of how farmers respond to the price indicator if agricultural policy makers are going to provide the right incentives at the farm level for expansion of cane production. This paper analyses the characteristics of the underlying technology in cane production and provides some insight into supply and cost structures at the farm level.

By way of summary, this paper achieves three major objectives;

(a) It analyses the contribution of the sugar industry to income generation and the production organizations that result from the present sugar manufacturing technology in the Lake Victoria Basin.

(b) It establishes the elasticity of substitution between capital and labour, returns to scale, cost and supply structures in four sugar cane zones in the Lake Victoria Basin.

(c) It discusses a possible expansionary policy which would be optimal from the point of view of employment, raw material production, factor pricing and final product pricing.

1.2 CANE PRODUCTION CONDITIONS AND INTERACTION WITH OTHER AGRICULTURAL COMMODITIES.

Sugar cane grows in the equatorial region and the tropics, and even in the warm temperate zones between 35° North and 35° South of the equator. By international standards, Kenya is still considered a marginal area for commercial sugar cane production. The major world producers are: Brazil, Cuba, India, China, Australia and Philippinnes, in that order.

On average, sugar cane requires a minimum rainfall of 1000 mm well distributed throughout the year but optimum rainfall requirement is 1500 mm if satisfactory growth and yield are to be realized. Most sugar cane growing areas of Kenya (with the exception of Bungoma, Nzoia and

South Nyanza) have variable and often deficient rainfall distribution which quite often result in poor yields. Altitude with its moderating effect on temperature has significant impact upon the duration of cane maturity and subsequent length of crop cycle. In Kenya, sugar cane is grown from a few metres above sea-level at Ramisi in Coast Province up to an altitude of about 2000 metres above sea-level in Nyanza and Western Provinces and parts of Rift Valley Province (Nandi and Kericho districts). The typical cane maturity period ranges from 22 to 24 months for plant crops and 18 to 22 months for ratoon crops in Western Kenya, while at the Coast it is 12 to 14 months for both plant and ratoon crops.

Soil-type is another important ecological factor affecting cane growth and yield. The coastal sugar zone has reddish-brown alluvial and sandy soil formations with relatively good drainage but low moisture-retaining capacity, thus making the coastal area more marginal and highly sensitive to dry spells. Nyanza Sugar Belt soils are invariably heavy "black cotton" soils with impeded drainage. In addition these soils are hard to break during dry seasons and too sticky and plastic during the rainy seasons, making them require heavy machinery for land preparation.

In Mumias, Nzoia and South Nyanza sugar zones the soils are relatively light textured and well-drained, making land preparation in these zones relatively less taxing.

The major sugar cane growing districts in the Lake Victoria Basin at present are: Kisumu, Bungoma, Trans-Nzoia, Nandi, South Nyanza and to a small extent Kericho, Siaya, and Kisii districts. It is, however, recognized that sugar cane tolerates a wide variety of soil conditions which makes almost the entire Lake Victoria Basin suitable for cane cultivation with the exception of only the very high altitude areas of Kisii, Nandi, Bungoma and Kericho districts.

In the areas immediately around Lake Victoria sugar cane has to compete for land with cotton and cereals such as maize and beans while in areas away from the lake it has to compete for land with coffee, maize and other cereals. Because sugar cane can do well in areas immediately around the lake and also in areas away from the lake, it provides a threat to cotton production which is ecologically restricted only to areas immediately around the lake.

A part from the geo-physical environmental factors mentioned above, sugar cane needs proper attention by the farmer if economic yields are to be realized.

Preparing land for the plant crop involves bush clearing, destumpting, levelling and grading while land preparation in the case of old cane land involves ripping and removal of old cane stumps. The soil is opened up by deep 1 ploughing and two rounds of light ploughing. Harrowing is then done to ensure a suitable soil tilth. Heavy machinery like the crawler tractors with heavy cultivators and subsoilers are used on the typical heavy soils of the Nyanza Sugar Belt while conventional wheel tractors with light ploughs and harrows or even ox-drawn equipment can be used successfully on the lighter soils of Mumias, Nzoia and South Nyanza.

After harrowing the land is furrowed to make appropriate "furrow holes" about 20 cm deep and spaced 1.2 metres to 1.8 metres apart. Ideally, seed cane should be from nurseries which had been established from heat-treated cane as a control measure against ratoon stunting disease but in practice most farmers use ordinary seed cane because of scarcity of the nurseries. The time of planting should coincide with the on-set of rains if proper cane establishment is to be ensured.

Sugar cane requires nitrogenous, potassic and phosphate fertilizers and lime. However, nitrogen remains the most important fertilizer for sugar cane because of little response noted from application of phosphate and potash in most cane producing areas. About 80 kilogrammes of nitrogen fertilizer per hectare in two split application during the rainy seasons is considered an ideal application rate for both plant and ratoon crops.

For good yields, cane fields should be kept weed-free throughout the crop life. Hand weeding is widely used in most sugar cane areas although large farms and factory nucleus estates extensively use herbicides and mechanical weed control. Weeding frequency depends upon climate and weed infestation rates in different cane areas, but four to five weedings before crop maturity is considered optimal.

Harvesting is done when cane is mature and millable. In most cases sugar cane is harvested by hand using the panga but Miwani factory has started using mechanical cane cutters. Ideally, cane should be sent for milling immediately it is harvested or not later than 48 hours after harvest to ensure high sugar content. Three harvests are obtained in a five year crop cycle in all cane growing areas except the Coast Province where a crop cycle takes only three years. The common practice on most farms is to extend the crop cycle by harvesting up to four or five ratoons before the fields are replanted with new crop. However, yield levels often drop with subsequent ratoon crops and this explains the common low yields on some old cane farms.

1.3 CANE PRODUCTION ORGANIZATIONS

Historically, sugar cane in Kenya has mainly been a plantation crop. At present, sugar cane production takes place under four major distinct types of farming organizations namely, factory nucleus estates, individual large-scale outgrowers' farms, Co-operative small-scale farms and Settlement farms.

Nucleus Estates:

The Kenya Government, though committed to encouraging small farmers' participation in monetary agriculture, still provides each sugar factory with a central plantation (nucleus estate) on the debatable grounds that these nucleus estates would ensure a steady and reliable source of cane supply to the factories. The Government supports this type of production organization by the a 'priori' reasoning that total reliance on the whims of outgrowers for cane supply may lead to underutilization of factory capacities. All the existing six sugar factories (Chemelil, Muhoroni, Miwani, Mumias, Ramisi and Nzoia) and the South Nyanza sugar factory in establishment stage have provisions for nucleus estates ranging from 3,000 to 5,000 hectares. Table 1 below shows that these nucleus estates takes a significant part of total cane area in each zone, accounting for 82.8 per cent of total area under cane in Ramisi, 30.8 per cent in Miwani, 28.6 per cent in Mumias, 21.9 per cent in Chemelil and 20.8 per cent in Muhoroni.

Table 1: Cane Land by Type of Producer (1975)

	Nucleus Estate		Large-Scale Farms		Small-Scale Farms	
Factory	Hectares	% of Total Cane Area	Hectares	% of Total Cane Area	Hectares	% of Total Cane Area
Mumias	3238	28.6	-	-	8094	71.4
Chemelil	2833	21.9	6475	50.0	3642	28.1
Muhoroni	2024	20.8	1214	12.5	6475	66.7
Miwani	3238	30.8	5666	53.8	1619	15.4
Ramisi	4856	82.8	202	3.4	809	13.8

Source: Economic Review of Agriculture, Vol. 7, No. 1, 1975, p.12.

In the same year (1975) factory nucleus estates supplied only 33.3 per cent of total cane output. This is an indication that factory nucleus estates' cane output failed to match their percentage share of total cane

area. In fact, the percentage share of the nucleus estates in total cane supply to the factories has been fluctuating in a declining trend as shown in Table 2 below:

Table 2: Cane Supply to Factories by Type of Producer 1971-76

	1971		1972		1973		1974		1975		1976	
	Tonnes	% share	Tonnes	% share	Tonnes	% share	Tonnes	% share	Tonnes	% share	Tonnes	% share
Nucleus Estates	434270	31.5	351967	33.1	534132	34.6	622056	36.2	551752	33.3	487328	29.5
Large Farms	532155	38.6	452399	42.6	570595	36.9	228358	13.3	124721	7.5	138353	8.4
Small Farms	411577	29.9	257929	24.3	440335	28.5	868669	50.5	978110	59.2	1514344	62.1

Source: Economic Surveys, 1975-1977.

From Table 2 we see that outgrowers (Large-scale and small-scale farmers) have been accounting for about 70 per cent of total cane supply to the factories each year while the nucleus estates have been accounting for only 30 per cent. The argument that total reliance on the whims of outgrowers may lead to underutilization of factory capacities is therefore not supported by evidence on historical performance of the outgrowers.

Furthermore, to provide room for these factory nucleus estates, the Government has had to migrate a large number of families from each factory zone; about 700 families had to be migrated from the Nzoia zone and over 1000 families had to be migrated from South Nyanza and Mumias factory zones. The migrated families were given compensation based on the current prices of land prevailing in each zone before the introduction of the sugar scheme. But it is common knowledge that the introduction of such a scheme increases the potential value of land and therefore bids up land prices quite substantially. Besides, the migrated families were not given alternative settlement so they could only hope to get land in the immediate outgrower zones of the sugar schemes. By the simple law of supply and demand, prices of land in the sugar schemes rose well above the compensation level. Having failed to get land immediately because of increased land prices and increased demand for land, most of the migrated families spend their compensation on other things so that we end up with not only landless people, but with landless poor people who cannot provide for themselves. We can see the social evils that accompany this organization of production: increased dependence, increased crime and increased pressure on land per family in the outgrower zones.

We therefore end up with a production organization which makes some local people better off and others worse off. If the former are made so better off that they can compensate the latter for their loss of welfare and still be left with some net gain then the organization would clearly introduce an element of economic efficiency in the sugar areas.

But what is more likely is that the fortunate farmers who gain by remaining in the sugar schemes as outgrowers cannot fully compensate the unfortunate farmers who are migrated from the schemes. This is mainly because the benefits derived from the nucleus estates accrue largely to foreigners and not to the local people. While the Government holds majority shares in the Lake Basin sugar factories (97% in Chemelil, 84% in Muhoroni, 75% in Mumias, 100% in Nzoia and over 99% in South Nyanza), the management and running of the factories is left almost entirely in the hands of foreign companies. Chemelil and Mumias factories are run by the Booker Agricultural International, Muhoroni and South Nyanza factories are run by the Mehta Group while Nzoia factory is run by a French company known as Techsucre. Miwani factory on the other hand is private enterprise run exclusively by the Indocha family.

Granting large pieces of land to foreign companies amounts to inviting foreigners into the country as industrial manufacturers of sugar and also as landlords in the sugar schemes. This is an unnecessary inducement to the foreigners since they account only for minority shares of capital inflow into the sugar schemes.

Lack of proper financial credit arrangements for the small-scale outgrowers has also meant that the same foreign companies enjoy a partial monopoly in the supply of agricultural inputs and farm services to the small-scale outgrowers for which they again reap substantial incomes which could have accrued to the local people. The factory nucleus estates thus have two undesirable implications:

(a) They minimize the say that the local farmers have in the running of the factories because the foreigners themselves control a significant part of cane supply to their own factories. Furthermore, they deny the local farmers the incomes that is generated on the estates. The accountability of incomes earned from the nucleus estates leaves a lot to be desired because Government representation in the factory managements is not capable of making sure that there is no cheating on the part of foreigners.

(b) The nucleus estates go contrary to the Government's stated objective of encouraging the participation of small farmers in monetary agriculture by themselves taking a significant part of total cane area in each sugar scheme.

If the nucleus estates are so vital to the factories (which is not supported by our statistical evidence), the they should be run as co-operative farms by the local farmers who are migrated from the sugar schemes so as to minimize welfare loss to the local people. The poor farmers with a higher marginal utility of income could run the estates in a much more efficient way than the foreign multinationals with relatively low marginal utility of income.

A second source of cane supply to the factories are the large-scale farms ranging from 40 hectares to 2000 hectares. We see in Table 1 that these farms account for 53.8 per cent of total cane area in Miwani 50.0 per cent in Chemelil, and 12.5 per cent in Muhoroni. Mumias, South Nyanza and Nzoia have no large-scale farms. From Table 2, we see that the contribution of the large-scale farms to total national cane supply has been diminishing partly due to increased number of small-scale farms and partly due to their own inability to cope with more diversified capital and labour inputs (internal diseconomies). Before Kenya attained political independence in 1963, these farms were exclusively owned by European and Asian Settlers. With the advent of political independence some of the farms changed hands through the Kenya Government's policy of Kenyanization. The process of Kenyanization led to subdivision of some large farms which resulted in smaller farm sizes and more farm units as compared with the pre-independence days. But farms as large as 2000 hectares are still a common feature of some parts of the Nyanza Sugar Belt.

In the broader study upon which this paper is based, we surveyed 50 farms in Mumias, 50 in Chemelil, 50 in Muhoroni and 28 in Miwani. All cane farms in each zone were first categorized by different growing locations and size of the farm before drawing a stratified random sample of an equal number of small-scale farms (below 40 hectares) and large-scale farms (above 40 hectares). In Mumias, all the 50 farms surveyed were small-scale farms because there are no large scale farms in the zone.

Our statistical results show average yields of 168 tonnes per hectare in Mumias which is exclusively a small-scale farm zone, 87.62 tonnes per hectare for large-scale farms and 100 tonnes per hectare on small-scale

farms in Chemelil zone, 60 tonnes per hectare on large-scale farms and 80.4 tonnes per hectare on small-scale farms in Miwani zone, 55 tonnes per hectare on large-scale farms and about 60 tonnes per hecate on small-scale farms in Muhoroni. The yields on factory nucleus estates were just about as low as the yields on large-scale farms in all the four zones. There is therefore evidence that large-scale farms and factory nucleus estates could very well be a source of production inefficiency in the sugar industry.

A third group supplying cane to the factories are the small-scale farms with well below 40 hectares. This group accounts for 71.4 per cent of total cane supply to Mumias factory, 66.7 per cent of total cane supply to Muhoroni factory, 28.1 per cent of total cane supply to Chemelil factory and 15.4 per cent of total cane supply to Miwani factory.

Most of the small-scale farmers have formed cane production and marketing cooperatives where the land is pooled and cultivated as a block. A few small-scale farmers operate their farm units individually and only co-operative at the marketing stage when their marketing co-operative societies make cane transport arrangements on behalf of the members. In Mumias, the small-scale outgrowers have formed an Outgrowers' Company which handles production and marketing activities with the help of the Outgrowers' Department of the Mumias Company. This is the production organization being established also for South Nyanza and Nzoia outgrowers so that the farmers can deal directly with the factories rather than indirectly through other intermediaries.

A large part of small-scale farms in Muhoroni zone are settlement farms which form a fourth source of cane supply. Muhoroni factory was established primarily to serve an area which used to be under European settlement. These European farms were bought out under the Million-Acre Settlement Scheme which provided for the settlement of landless Kenyans on high density schemes and of those Kenyans on low density schemes who could raise a cash deposit of KShs. 10,000. With a few exceptions, the original farms were subdivided into 1.01 hectares subsistence plus 3.03 hectares sugar cane plots, the sugar cane plots being farmed in blocks under the central direction of the Settlement Sugar Organization (S.S.O.) is managed by the Ministry of Lands and Settlement. The holdings under the Million-Acre Scheme are grouped into 8 settlement schemes, each with its own co-operative society. Responsibility for different cultivation activities is divided between the S.S.O., the co-operative societies and the individual farmers. However, a good number of farmers in these schemes are individuals

holding very well paying jobs in national and international organizations. Such individuals form a group of "Absentee Landlords" (telephone farmers) who have left their fields entirely under various co-operative societies and the S.S.O. This explains the relatively low yields on small-scale and large-scale farms in Muhoroni zone.

Most of the small-scale non-settlement outgrowers' co-operatives in the Nyanza Sugar Belt operate under the central direction of the Sugar Belt Co-operative Union (S.B.C.U.) which was formed in 1970 mainly because of discontent of the outgrowers with company supplied production and marketing services. Primary societies of the S.B.C.U. were divided into to two categories: production societies containing blocks of cane, and marketing societies in which members farmed their individual cane plots and only co-operated at the marketing stage. Later a third type of society was incorporated in the S.B.C.U.: farm purchase societies which had bought previous non-African owned large-scale farms. The Union's responsibilities in regard to production and marketing functions on cane blocks required a high degree of management and technical knowledge so that in February 1973 an Agreement was signed between the S.B.C.U. and a German company, Friedrich Ebert Stiftung (FES), to provide financial, advisory and management assistance to the S.B.C.U. In addition to this, the S.B.C.U. continued to get financial and advisory help from the sugar companies and the Ministry of Agriculture through the Kenya Sugar Authority. The active involvement of the F.E.S. personnel.in the execution of S.B.C.U. functions led to conflict of responsibility and now the Government is considering establishing a production organization of the type that exists in Mumias, South Nyanza and Nzoia which enables farmers to deal directly with the sugar factories.

By way of summary, we have established a strong case for the multiplication of small farm units on the basis of their yield performance and their share of total cane supply to the factories.

1.4 CANE MARKETING

Sugar cane is a typical industrial crop for which farmers have no direct use; all cane harvested must be sold either to the sugar factories or to the jaggery factories. In most established sugar zones, jaggery production and "chewing" of sugar cane are legally prohibited and sugar cane produced in such zones must be purchased monopsonistically by the sugar factories.

Competition among sugar factories in the Nyanza Sugar Belt for cane procurement is thoroughly restricted and discouraged by the Kenya Government through a strict zoning scheme which assigns individual cane producers and Co-operative societies to specific factories to which they must deliver their cane. No farmer or co-operative society is allowed to supply cane to a factory other than that assigned in the zoning scheme without permission from the Government.

The zoning scheme has become a major source of discontent among farmers in the Nyanza Sugar Belt. Our survey shows that out of 50 farmers interviewed in Chemelil zone, 35 farmers would have preferred to market their cane in Muhoroni which is more conveniently located to them than the Chemelil factory. Some of these 35 farmers have to transport their cane an additional distance of as much as 10 miles by having to market their Cane in Chemelil instead of Muhoroni. Out of 50 farmers interviewed in Muhoroni zone, 26 farmers would have preferred to market their cane in Chemelil because being assigned to Muhoroni makes some of them transport their cane up to 8 additional miles. Out of 28 farmers interviewed in Miwani zone, 15 farmers would have preferred to market their cane in Chemelil on the basis of transportation cost considerations.

The need to have a zoning scheme in the Nyanza Sugar Belt came as a result of poor planning which resulted in three large factories being established in one small geographical area. While we accept this as a mistake already made and one whose correction may be very expensive, there is an urgent need for the Government to review the zoning scheme so as to minimize loss to farmers due to additional transportation costs.

The Kenya Sugar Authority has directed sugar factories to charge the following cane transportation rates:

Upto 10 km from factory - KShs. 25.00 per tonne
11 km - 16 km from factory - KShs. 28.00 per tonne
17 km - 24 km from factory - KShs. 32.00 per tonne
25 km - 32 km from factory - KShs. 34.00 per tonne.

Beyond 32 km from factory, it is left to the farmer to decide whether or not it would be economic to produce sugar cane. If the farmer decides to produce cane, he has to make his own transport arrangements. In practice, however, the factory transport facilities are so limited that most farmers end up making their own transport arrangements with private transport firms which charge higher rates.

A second source of discontent with the cane marketing system was noted particularly in Chemelil and Mumias zones. This is the problem of too frequent stoppage of cane intake on the grounds that the factory machines are being serviced. It has become a general practice of the personnel of these two factories to close the factories in the months of December and January when they go for Christmas holidays even when the factory machines are not being serviced. This practice causes considerable inconvenience and income loss to farmers whose cane matures for harvesting in these two months. It must be noted that cane loses considerable weight when left to overmature. Furthermore, the unfortunate farmers whose cane gets burnt accidentally in the months of December and January have to incur considerable income losses.

Incorrect weighing of cane appears to be a common source of discontent among farmers in all zones. There is a strong feeling among farmers that some dishonest farmers bribe the factory personnel who weigh cane at the factory level so as to have more tonnage recorded for them than they have actually delivered. In order to do this without raising suspicion from the factory management, the weighers record less tonnage than actual deliveries for the honest farmers. This is an allegation which should be thoroughly investigated so that a stop is put to the practice immediately.

Lateness in paying the farmers after they have delivered their cane to the factories is a factor which contributes to poor maintenance of the cane fields particularly on the part of poor small farmers who have no easy access to credit from financial institutions. Such farmers rely entirely upon their cane proceeds to maintain their fields.

1.5 CANE PRICING AND INCOME GENERATION

Cane prices are fixed and often reviewed by the Government only after farmers have made several appeals to the Government. Table 3 below shows that price to cane producers has been increasing only gradually in the 14-year period between 1966 and 1979:

Table 3: Cane Prices to Producers (1966-79)

Year	1966	1967	1968	1969	1970	1971	1972
Shs/ tonne	40.20	40.20	46.00	45.20	45.20	45.20	50.00
Year	1973	1974	1975	1976	1977	1978	1979
Shs/ tonne	51.80	61.80	89.40	104.50	133.00	133.00	133.00

Source: Statistical Abstracts 1966-1978 and Economic Review of Agriculture, Vol.7 No.1, 1975.

We note that they have remained constant for a good number of years while we know that cost of agricultural inputs and cost of living (prices of consumer commodities) ahave been increasing much more rapidly.

While fixing of cane price by the Government is necessary to ensure a steady flow of income to cane producers, the fixed price should be reviewed constantly by the Government to make sure that prices of farm inputs and the cost of living do not grow out of proportion with farm incomes.

The costs of producing one hectare of cane are given in Table 4 below:

Table 4: Costs of Production Per Hectare (KSA recommendations)

Production Operation	Equipment Used	Hours take Per hectare	Rate in Shs/hectare	Cost Per hectare
Land Preparation	D8 or D7 + Ripper	2.00	370.00	740.00
First Ploughing	D8 or D7 + Ripper	1.53	370.00	570.00
Second Ploughing	Tractor + Plough	4.00	86.50	346.00
Harrowing	D8 or D7 + Harrow	1.42	370.00	525.00
Furrowing	Tractor + Ridger	1.66	110.00	183.00
Grading	Motor Grader	2.00	195.00	390.00
Subsoiling	D6 + Subsoiler	1.66	250.00	417.00
5 Weedings	Labour	750 Man-days	13.00	9750.00
Fertilizer		9.60 bags	80.00	768.00
			Total	Shs.13,689.00

If we take the high yield sugar cane zones of Mumias, Nzoia and South Nyanza (168 tonnes per hectare), we have to add harvesting cost at the rate of Shs. 5.00 per tonne and transportation cost at the rate of Shs. 25.00 per tonne for a farm within 10 km from the factory:

Harvesting cost for 168 tonnes at Shs 5.00 = KShs. 840.00
Transportation of 168 tonnes at Shs 25.00 = KShs.4200.00
Total = KShs 5,040.00

For a farm beyond 24 km from the factory, the transportation rate is KShs 34.00 per tonne which yields a transportation cost of Kshs 5,712.00 per hectare and a total of harvesting and transportation cost of KShs 6,552.00. Total production and marketing costs amount to KShs 18,729.00 and KShs 20,241.00 for a one-hectare farm within 10 km and above 24 km from the factory, respectively.

Using the 1979 price of KShs 133.00 per tonne of cane, we obtain gross revenue of KShs 22,344.00 per hectare, which yields a net income figure of KShs 3,615.00 for a one-hectare farm within 10 km from the factory and KShs 2,103.00 for a one-hectare farm over 24 km from the factory. For the subsequent ratoon crops, these net income figures would increase to KShs 6,786 for a one-hectare farm within 10 km from the factory and KShs. 5,274.00 for a one-hectare farm within the range of 24 to 32 km from the factory.

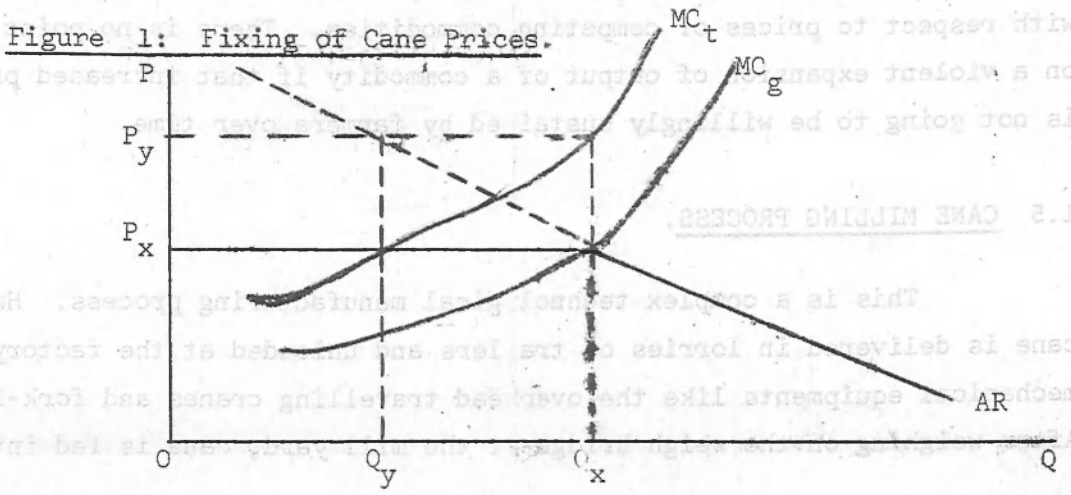
A farmer owning one hectare of cane within 10 km from the factory therefore earns an average of KShs 3,437.00 per year (or KShs 286.41 per month) while a farmer with one hectare of cane 24 - 32 km from the factory earns an average of KShs 2,530.20 per year (or KShs 210.85 per month), within the five year crop cycle. These average income figures are much lower in the older cane zones of Miwani, Muhoroni and Chemelil with average yields of 100 tonnes per hectare and below.

Since the majority of sugar cane growers are people with low educational or training skills, and therefore low opportunity cost, two hectares of cane provides the farmer with an income (KShs 420-580) which just brings the farmer to a point of indifference between staying on the land or moving out to look for wage employment.

It is therefore the view of this paper that cane prices have been fixed at too low a level to be able to provide adequate incentives to farmers to increase their production and also to potential farmers who are seeking wage employment in Kenya's urban centres to come back to the land and make good use of it.

Sugar cane at the price of KShs 133.00 per tonne still offers negative surplus to producers in the sense that the true marginal cost curve of the industry is higher than the marginal cost curve operative in Government fixed prices as illustrated in Figure 1 below:

Figure 1: Fixing of Cane Prices.



In Figure 1 above, the MC_t is the true marginal cost curve which measures the true marginal sacrifice which sugar cane producers must make to provide each marginal unit of output at different levels of output. The MC_g is the marginal cost curve which the Government perceives as being representative of the marginal sacrifice situation in the industry. The Government uses this MC_g curve to fix sugar cane price at P_x, with the hope that Q_x units of cane will be provided. But for the farmers to provide Q_x units of cane, they need a higher price P_y. Because price is fixed at P_x, farmers will supply only Q_y units at which level of output the marginal sacrifice is equal to the factory demand price.

Because of the low price of sugar cane, the commodity faces a big competition from coffee on the higher areas of the Lake Victoria basin and also from maize and other cereals on the higher and lower parts of the basin. At the current market prices, coffee offers an annual income of KShs 15,100.00 (KShs.1,258.00 per month) while Maize offers an annual income of KShs 9,600.00 (or KShs 800.00 per month). Cotton is still not so much of a threat to sugar cane but with improvement in cotton yields and prices, it could very well be a threat to sugar cane.

A long-term solution to the problem would be for the Government to assess the actual cost situation in the industry and fix cane price in line with the prevailing cost structure at each particular point in time. It may appear that farmers are already responding well to the Government's call for increased production of sugar cane by seeing that the country is very rapidly approaching self-sufficiency in cane production. This is not so. What is happening is that the Government has simply been imposing sugar schemes on local farmers and the farmers then have no choice but to grow sugar cane. Production is very much an economic phenomenon and to set production targets without appropriate incentives to the farmers is to do the wrong job. While it is clear that Kenya will soon become self-sufficient in sugar production, sustaining the self-sufficiency will very much depend on the relative price of sugar cane with respect to prices of competing commodities. There is no point in embarking on a violent expansion of output of a commodity if that increased production is not going to be willingly sustained by farmers over time.

1.5 CANE MILLING PROCESS.

This is a complex technoligical manufacturing process. Harvested cane is delivered in lorries or trailers and unloaded at the factory by mechanical equipments like the overhead travelling cranes and fork-lift trucks. After weighing on the weigh bridge at the mill yard, cane is fed into cutter

Units and shredders which prepare the mass of cane for rollers (or mills) where it is squeezed to extract the juicy content. From the rollers, juice is collected separately from the waste material (bagasse). The bagasse is collected separately for use as fuel at the boiler.

The juice is then strained through screens and heated and limed or phosphated to prevent conversion of sucrose into simple sugars. This process known as "clarification of the juice" results in precipitation and separation of suspended matter and soluble non-sugars in the juice. The juice is then further led to evaporators where further boiling takes place to remove water but at a low pressure to prevent darkening or browning of sugar due to burning.

The next process is crystallization where the thick syprup obtained from the evaporators is fed into vacuum pans where a super-saturated mixture of molasses and sucrose crystals form the massecuite. The massecuite is then led to crystalizers (open pans) where it is agitated by stirring to encourage growth of sugar crystals. The massecuite is then purged in automatic centrifugals with a modicum of washing which separates the crystals from the molasses. There are three "boilings" which produce three different qualities of sugar. The final molasses is drained from the third boiling. The sugar crystals are then dried and bagged in 100 kg. bags which are then stored in the factory stores ready for distribution to K.N.T.C. which is the Government appointed distributor of sugar in Kenya.

The sugar produced in Kenya is what is called "mill-white sugar" or "commercial raw sugar". Refined sugar for industrial use reaches our domestic users only through import channels. The Kenya-produced sugar has a brownish colour due to incomplete removal of molasses coating. The extent of browness varies from factory to factory depending on the processing methods. The Kenyan Government has, however, put a minimum quality standard as regards colour and content of impurities in sugar. This standard is based on the International Commission For Uniform Methods of Sugar Analysis (ICUMSA) Unit. The Kenya Bureau of standards requires locally produced sugar to range from 300 to 500 ICUMSA Units (taking refined sugar to be 100 such units). The lower the units, the whiter the sugar but the more costly it becomes to produce because it calls for refining processes which entail additional expenditure of energy and chemicals.

It is therefore not surprising that Kenyan sugar factories tend to produce brown sugar given that they have to sell all their sugar at a Government fixed price irrespective of the extent of refining, as long as it is within the acceptable ICUMSA unit range. Miwani and Muhoroni factories have machinery for complete refining of sugar, but their use was stopped because it proved

uneconomic to produce refined sugar in a situation of uniform sugar price. The factories would be losing about 30 per cent of the raw sugar equivalent by weight in the refinery. However, nutritionists argue that the brown sugar is more nutritious than the refined sugar and that the refined sugar could very well be a cause of dangerous diseases like heart failure. Refined sugar would thus find its most important use only in industrial processing of other commodities like soft drinks, beer and fruit juices.

1.6 BY-PRODUCTS.

The range of utilization of the by-products of sugar manufacture in Kenya is still limited. At present there are only two by-products of some economic importance:

Bagasse: This is the fibrous stem left after extracting juice from sugar cane. At present bagasse finds its most important use as fuel in the factory boilers. It provides a significant saving on fuel oil particularly in the face of increasing oil prices. In some sugar producing countries bagasse finds use in the manufacture of particle board, plastic paper and high quality paper. In Kenya, however, the high cost of replacing bagasse with fuel oil has retarded the move towards greater industrial use of bagasse. This is an area which our physical scientists should exploit simultaneously in their search for a cheaper substitute for fuel oil for factory boilers.

Molasses: This is the most important by-product of sugar manufacture in Kenya to-day. Some of it is sold locally as an ingredient in cattle feeds while some is used by the local people to brew a popular native beer (Chang'aa) and some is used for the manufacture of spirits. So far, only Miwani factory has distillery for spirits but its capacity is so limited that it cannot cope even with the molasses from Miwani factory alone. However, the distillery supplies enough spirits for the domestic market and a surplus for export. Molasses from other factories which cannot be sold domestically is exported in raw form but, due to lack of storage and rail-transport facilities, some factories have had to run some of their molasses to waste. Table 5 below gives production and export figures for molasses for the period 1967 to 1975.

Kenya exports molasses mainly to Britain and the United States of America, at average price of KShs 320 per tonne (f.o.b. Mombasa). Molasses is therefore a significant source of foreign exchange earnings to the country and it provides additional money incomes to the sugar factories. However, since the domestic uses still take only a small part of molasses, a lot of it has since been run to waste.

Fortunately, construction has started in Kisumu of a factory which would utilize molasses for the manufacture of power alcohol, spirits, vinegar, acetric acids and other industrial products. This is a joint venture between the Government of Kenya (51% shares) and the Madhvani Group (49% shares) and it is a welcome idea because the 49% shares held by the Madhvanis constitutes a significant capital inflow into Kenya. Plans are also under way to construct a second molasses factory in Muhoroni which will be jointly owned by the Kenya Government and the Mehta Group. One only hopes that a proper feasibility study has been carried out to establish that the quantity of molasses that will be available in Kenya by 1983 when all factories will be running fully will be sufficient to supply the two factories adequately.

Table 5: Production and Export of Molasses 1967-75.

Year	Production (tonnes)	Export (tonnes)	% of Total Production	Balance (tonnes)	% of Total Production
1967	24200	14570	60.2	9630	39.8
1968	32600	17370	53.3	15230	46.7
1969	46200	35200	76.2	11000	24.8
1970	50100	24830	49.6	25270	50.4
1971	46600	29260	62.8	20340	37.2
1972	36900	23710	64.3	13190	35.4
1973	55200	32400	56.7	22800	43.3
1974	65800	24260	36.9	41540	63.1
1975	63840	38750	60.7	25090	39.3

Source: Small-scale Sugar Project Report, Vol. 2, p.11, Ministry of Agriculture.

What is particularly important about the molasses factories is that they will be producing power alcohol which will provide a significant source of saving of foreign exchange currently being spent on petrol because the power alcohol will be mixed with premium petrol (20% petrol and 80% power alcohol) to work just as well as the pure petrol. This will enable the country to maintain a reasonable price level for petrol so that the sugar factories can use fuel oil power in their boilers and release bagasse for the manufacture of other industrial products of economic importance.

What is still not very clear here is who is going to claim ownership of the molasses sold to the two factories. Since molasses is a by-product of the processing of cane into sugar, both the farmers and the factories (to a small extent) should claim its ownership and the incomes earned from molasses sales

should be divided in some fair ratio between the farmers and the sugar factories. Granting exclusive claim on molasses to the sugar factories would simply make the foreign sugar manufacturers recover the dollar worth of their initial investment (which is laready shown to be small in most factories) much faster than previously planned in the original contracts and they could easily reap abnormal profits from their small investments if income from molasses sales is not properly accounted for.

One simple solution to this problem is to let the incomes earned from molasses sales reduce the domestic sugar prices so as to being the country to a position where it can export sugar competitively and also to give access to a greater proportion of Kenya's population to sugar consumption. This would simply be a transfer of "surplus" from the local producers to Kenya's domestic consumers with little loss of total welfare of the Kenyan people. Of course, it may also amount to a small transfer of surplus from the sugar manufacturers to domestic consumers which is not a bad idea if the foreigners are also prepared to create a good working relationship with the domestic economy.

The paper is therefore recommending increased price to cane producers and reduced consumption price of sugar. These recommendations may appear to be contradictory on the surface and we show in the next section that there is sufficient scope for achieving the two objectives without much contradiction.

1.7 SUGAR PRODUCTION AND PRICING.

Kenya is still a net importer of sugar with domestic consumption standing at 260,000 tonnes while domestic production is only 238, 145 tonnes (1978 figures). Kenya's neighbouring countries, particularly Uganda, have been experiencing persistent shortages of sugar and this has made smuggling of sugar into the neighbouring countries an attractive and very lucrative business. This illegal trade has quite often led to localized sugar shortages in Kenya. The Government has therefore been forced to have some control over the marketing of sugar. This control was reinforced in 1973 when sugar cane and sugar were declared "Special Produce" under Section 190 of the Kenya Agricultural Acts which also established the Kenya Sugar Authority to act as a link between the Government and the sugar industry.

Sugar in Kenya is currently being produced by eight factories namely, Chemelil, Muhoroni, Miwani, Mumias, Ramisi, Nzoia, Yala and Kabras. The South Nyanza factory is scheduled to start producing sugar in 1981. Mumias factory currently accounts for the largest share of Kenya's total sugar production,

followed by Chemelil, then Muhoroni, Miwani, Ramisi, Nzoia and the small scale factories of Yala and Kabras, in that order as shown in Table 6 below:

Table 6: Domestic Production of Sugar (1975 and 1978).

Factory	Cane (tonnes)	Sugar (tonnes)	Market share %	Cane (tonnes)	Sugar (tonnes)	Share %
Mumias	513,154	59,207	37.0	809,900	92,500	41.8
Chemelil	413,637	39,921	25.0	502,755	47,408	19.0
Muhoroni	309,022	26,356	16.0	444,416	42,331	17.0
Miwani	304,202	26,722	17.0	415,000	36,417	15.0
Ramisi	111,163	7,505	5.0	163,000	11,450	4.0
Nzoia	-	-	-	73,638	7,339	3.0
Yala and Kabras	-	-	-	11,200	700	0.2

In the 18 - year period between 1960 and 1978, total domestic production of sugar grew at an average rate of 36.6 per cent per annum while domestic consumption grew at average annual rate of 18.3 per cent. It is therefore clear that when South Nyanza and Nzoia factories acquire full operation in 1983, Kenya will not only become self-sufficient in sugar production but she will also have a substantial surplus whose disposition calls for an urgent consideration. Kenya sugar prices are still much higher than the world sugar prices and the country cannot export sugar without heavily subsidizing the world consumers at the expense of domestic consumers and producers. The current domestic consumer price of sugar is KShs 4,500 per tonne while the world price is only KShs 1,613 per tonne.

There is an urgent need to bring down domestic sugar price in line with the world price if the country is going to find a way of disposing of her surpluses. It is, however, the view of this paper that domestic sugar prices have remained unnecessarily high mainly because the sugar price structure in Kenya is very heavily burdened with Government levies in the form of excise duty, sugar import equalization fund and distribution costs. Table 7 below gives the structure of sugar prices in Kenya for the period 1971 to 1976.

Analysis of Table 7 reveals that Government levies (Excise duty, Import equalization charges and KNTC profit margin) accounted for 40 per cent of sugar consumption price in 1976 while payment to sugar factories accounted for 51 per cent. This latter figure implies that the sugar factories pay the farmers only 5 per cent of what they are paid by the Government. Payment

Table 7: Structure of Sugar Prices 1971-76 (Shs/Tonne)

	1971	1972	1973	1974	1975	1976
Price to Factories	904.90	1080.00	1080.00	1230.00	1860.00	2300.00
Excise Duty	440.90	440.90	440.90	440.90	440.90	440.90
Import Equalization Fund	100.00	100.00	100.00	500.00	800.00	1376.00
KNTC Distribution Costs	24.70	49.10	49.10	49.10	71.50	70.00
KNTC Profit Margin	18.00	18.00	18.00	18.00	37.60	17.00
KNTC Price to Wholesalers	1488.50	1688.00	1688.00	2238.00	3210.00	4203.90
Wholesalers' Margin	34.00	34.00	34.00	34.00	40.00	59.00
Wholesalers' Price to Retailers	1522.50	1722.00	1722.00	1722.00	3250.00	4262.
Retailers' Margin	127.00	128.00	128.00	128.00	250.00	235.00
Retail Price to Consumers	1650.00	1850.00	1850.00	2400.00	3500.00	4500.00

Source: Tate Report, Ministry of Agriculture, p.81.

to farmers is only 2 per cent of the sugar consumption price. One wonders why sugar cane which is the single most important input into sugar manufacture should account for only 2% of the consumption price of sugar. It is even more distrubing to try to figure out why sugar factories should pay farmers only 5% of what they get from the sale of sugar. The sugar import equalization fund was established to finance the difference between import prices and domestic prices whenever the former turned out to be greater than the latter. But sugar import prices have persistently remained below domestic sugar prices. One wonders why import equalization charge has increased by 1276% from Shs 100 in 1971 to Shs 1376 in 1976.

An interview with the Kenya Sugar Authority revealed that the equalization fund money is going to be invested in the improvement of infrastructure in the sugar cane growing areas. That is a welcome idea as far as the sugar cane producers are concerned because they must have generated this surplus both as cane producers and also as sugar consumers. But we must not forget that a good part of the surplus was generated by sugar consumers. Using the money to develop infrastructure in the sugar growing areas simply amounts to a transfer of incomes from all sugar consuming areas to sugar producing areas which is not a fair transfer of incomes particularly from the point of

view of poor sugar consumers in North Eastern Province of Kenya. The sugar import equalization fund could have been abolished a long time back after establishing the international comparative advantage in sugar production.

The economic justification for imposing excise tax on a commodity like sugar which has become so important in the diet of an average Kenyan family is not very clear. What it does is to deny the majority of the families (including some cane producing families) the right to consume the commodity which has assumed a great deal of prominence in the daily diets.

One wonders again why KNTC which is supposed to be a non-profit making body should be allowed any profit margin over and baove the distribution costs. Doing that defeats the whole purpose of such a parastatal body. We therefore come to the conclusion that prices to cane farmers could be increased and domestic sugar prices could be reduced substantially through a greater economic use of the by products of sugar manufacture and also by eliminating unnecessary Government levies on the finished product.

1.8 THE MODELS.

We have so far considered only what happens in pricing and marketing of cane and sugar. We now turn our attention to the characteristics of the underlying technology in cane production.

There are many alternative specific production functions, which can be used to analyse production, cost and supply structures but there is no way by which one can choose any one particular function by 'a priori' reasoning. The best that one can do is to choose a production function from a given set of alternative functions on the basis of their "goodness of fit". In this paper we have tested three popular types of production functions namely, the Cobb - Douglas, the CES, and the VES with a view towards establishing that function which best fits the sugar cane data in the Lake Victoria Basin.

In its best known form, the Cobb - Douglas production function is written as:

$$Q = AL^{\alpha}K^{\beta} \qquad (2)$$

where Q measures cane output, K the quantity of capital input, and L the quantity of labour input. α, β and A are the parameters of the function to be estimated.

This production function is based on the assumption that elasticity of substitution between capital and labour is unitary, which is a rather restrictive assumption to make with respect to sugar cane production where the underlying technology appears to be allowing flexible substitution between farm machinery and labour.

The CES production function is expressed as:

$$Q = \gamma \left[\delta K^{-\rho} + (1-\delta)L^{-\rho}\right]^{-v/\rho} \qquad (3)$$

where γ, δ, ρ and v are the parameters of the function to be estimated.

The VES production function can be expressed as:

$$Q = \gamma K^{\alpha(1-\delta\rho)}\left[L + (\rho-1)K\right]^{\alpha\delta\rho} \qquad (4)$$

where γ, α, δ and ρ are the parameters of the function to be estimated.

This production function relaxes the Cobb-Douglas and CES assumptions by allowing the elasticity of substitution between capital and labour to vary with the level of relative factor use instead of being a constant.

Once the parameters of these three production functions have been estimated, the cost and supply functions can easily be extracted from the explicit forms of the production functions.

Data and Specification of Variables:

To estimate these production functions, we had to generate cross-section data on sugar cane output, labour input, capital input, and the average money wage rate paid to cane farm workers in four sugar zones in the Lake Victoria Basin namely, Chemelil, Muhoroni, Mumias and Miwani. The survey covered 50 sugar cane farms in each of the first three zones and 28 farms in Miwani. The data were generated over the crop year beginning December 1975 and ending December 1977.

For the purpose of sampling, we used the sugar growers' co-operative societies' registers and the sugar factories' cane delivery registers to categorize the cane growers in each zone into different growing locations and different size operations. An equal stratified random sample of large-scale and small-scale farms was selected in each zone except in Mumias where there are no large-scale farms.

The output variable was taken as actual cane harvest in tonnes for each farm surveyed. The labour variable was measured in terms of a standardized unit, "the equivalent man-day", and the capital variable was measured in another standardized unit, "the equivalent tractor hour" to make allowance for capacity utilization of various farm implements. The data under capital relate to actual tractor-hours spent in different production and marketing operations. To this figure we added annual gross investments during the period of the survey. The items covered in annual gross investments included repair, maintainance of farm machinery, loan repayment on farm machinery and land purchases. These figures of annual expenditures incurred by each farmer were converted into "equivalent tractor hours" by dividing them by the appropriate cost of a tractor hour in each zone. The average money wage rate was obtained by dividing each farmer's total wage bill for the period of the survey by the total number of man-days employed in that period.

Regression Results:

Equations (2), (3) and (4) were fitted by ordinary least squares technique to the cross-section data for each of the four zones. On the basis of the adjusted coefficient of multiple determination, R_2^2, equation (3) fitted the cane data quite well, followed by equation (4). Equation (2) did not perform well.

On the basis of the t - statistic, equation (2) produced insignificant results in all the four zones even at the level of significance of 0.25 while equations (3) and (4) produced significant results in all the four zones at the level of significance of 0.025. These results rule out the Cobb-Douglas assumption of unitary elasticity of substitution between capital and labour in the cane production process.

Returns to Scale:

All the three production functions produced fairly uniform degrees of returns to scale for all the four zones. The Cobb-Douglas function produced degrees of returns to scale of 0.366 for Chemelil, 0.674 for Miwani, 0.984 for Muhoroni and 0.942 for Mumias. The CES production function produced degrees of returns to scale of 0.378 for Chemelil, 0.666 for Miwani, 0.984 for Muhoroni and 0.942 for Mumias. The VES function produced degrees of returns to scale of 0.398 for Chemelil, 0.826 for Miwani, 0.988 for Muhoroni and 0.986 for Mumias.

These results indicate that cane production is already encountering severe decreasing returns to scale particularly in the typical large-scale farm zones of chemelil and Miwani where the degrees of returns to scale are significantly less than Unity. A reduction of the average cane farm size in these zones would significantly improve the profit position of farmers by reducing their average cost of production. This point is reinforced by our statistical results on the relative cost structure in the Lake Basin sugar industry. While all the four zones experience internal diseconomies of scale (increasing long-run average cost), the average cost in the cane producion rises much faster with output in the typical large-scale farm zones of Chemelil and Miwani than it does in Mumias and Muhoroni. Reduction of the average farm size in the large-scale zones could reduce the severity of diseconomies of scale. What deserve special attention are the very large-scale farms over 100 hectares. Such farms are most likely the main source of production inefficiency due to lack of entrepreneural ability to cope with the more diversified capital and labour inputs that theyycall for.

Elasticity of Substitution:

The elasticity of substitution between capital and labour is unitary by the Cobb-Douglas assumption. This assumption has been proven wrong in cane production in the Lake Victoria Basin by the poor statistical performance of the Cobb-Douglas function. The CES and the VES functions have produced fairly similar elasticities of substitution between capital and labour for all the four zones. The CES produced elasticities of substituion of 1.19 for Chemelil, 1.20 for Miwani, 1.25 for Muhoroni and 1.40 for Mumias, while the VES function produced elasticities of substitution of 1.28 for Chemelil, 1.39 for Miwani, 1.27 for Muhoroni and 1.46 for Mumias.

It is clear from these results that the elasticity of substitution between Capital and Labour in the Lake Basin sugar industry is greater than Unity and very close to 1.30. The sugar industry therefore offers substantial substitution possibilities between capital and labour at the farm level, a fact that calls for very careful factor pricing policy in the industry. In terms of relative factor shares, any policies deliberately aimed at making farm machinery and other labour - displacing inputs cheaper in relation to farm wages would simply reduce the relative share of labour in total output. This would create unemployment in an industry situated in one of the most densely populated areas in the country (about 169 persons per square kilometre).

BIBLIOGRAPHY

1. Ady, P "Trends in Cocoa Production," Bulletin of the Oxford University Institute of Statistics, Vol. 2, pp 389-401, 1949.

2. Arrow, K.J. Chenery B.S., Minhas and Solow, R.M.: "Capital-labour Substitution and Economic Efficiency," The Review of Economics and Statistics, 1961.

3. Baterman, M.J. "Aggregate and Regional Supply Functions for Ghananian Cocoa," Journal of Farm Economics, Vol.47 pp 384-401.

4. Baver, P.T. and Yamey, B.S.: A Case Study of response to Price in an Underdeveloped country," Economic Journal, Vol.69 pp 800-805, 1959.

5. Berringer, C. Estimating Enterprise Production Functions From Input - Output Data on Multiple Enterprise Farms," Journal of Farm Economics, Vol. 38, pp 923-930, 1956.

6. Dean E: "Economic Analysis and African Response to Price," Journal of Farm Economics, Vol. 47, pp 402-409, 1965.

7. ———— The Supply Responses of African Farmers: Theory and Measurement in Malawi. North-Holland Publishing Co, Armsterdam, 1966.

8. Drake, L.S. "A Method of Showing Farmers how to Estimate Gross Income and Marginal Productivity" Journal of Farm Economics, Vol. 36 pp 66-77, 1954.

9. Drymes, P.J. "Same Extensions and Tests for the CES class of Production Functions" The Review of Economics and Statistics, Vol. 47, Nov. 1965.

10. Enke,: "Production Functions and Capital Depreciation, "Journal of Political Economy, Vol. 70, pp 368-379, 1962.

11. Eherington, D.M.: An Econometric Study of Smallholder Tea Production in Kenya. Ph.D. Thesis, Stanford University, 1970.

12. Griliches, Z: "Specification Bias in Estimates of Production Functions," Journal of Farm Economics, Vol. 39, pp 8-20, 1957.

13. Gwayer, G.D.: "Long-and Short-Run Elasticities of Sisal Supply," Eastern Africa Economic Review, December 1971.

14. Harris, J.R. and Todaro, M.P.,:"Wages, Industrial Employment and Labour Productivity: The Kenyan Experience," Eastern Africa Economic Review, Vol. 1 No.1, June 1969.

15. Hawtrey, R: "Production Functions and Land: A New Approach" Economic Journal, NVol. 70, pp 114-124, 1960.

16. Heady, E.O. and Dillon, J.L. : Agricultural Production Functions, Ames 1962.

17. Heady, E.O. Johnson G.L. and Hardin, L.S.: Resource Productivity, Returns to Scale and Farm Size, Ames, 1956.

18. Henderson, J.M. and Quandt, R.E.: "Microeconomic Theory: A Mathematical Approach. McGraw Hill Book Co. Inc.

19. House, W.J.: "Wages, Employment and Productivity in Kenyan Small Scale Industry: Further Evidence," Eastern Africa Economic Review, Vol. 5, No.1 June, 1973.

20. Johnston, J.: "Statistical Cost Functions: A Re-Appraisal," The Review of Economics and Statistics, Vol. 40, 1958.

21. Klein, L.R. : "MacroEconomics and the Theory of Rational Behaviour," Econometric, Vol.14, pp 93-108, 1946.

22. ——— "Remarks on the Theory of Investment," Econometrica, Vol. 14, pp 303-312, 1946.

23. ——— : An Introduction to Econometrics London, 1962.

24. ——— : An Estimation of the CES Production Function," International Economic Review, Vol. 8, pp 180-189, 1967.

25. Maitha, J.K.: "Capital-Labour Substitution in Manufacturing in a Developing Economy: The Case of Kenya," Eastern Africa Economic Review, Vol. 5, No.2 December, 1973.

26. ——— : "The Employment Problem in Kenya: Capital-Labour Substitution in the Economy," ILO, Geneva, March 1976, p. 42.

27. ——— : "A Note on Distributed Lag Models of Maize and Wheat Production Response: The Kenyan Case," Journal of Agricultural Economics, Vol.XXV, No.2, 1974.

28. Moroney, J.R.: "Identification and Specification of Analysis of alternative Equations for Estimating the Elasticity of Substitution," Southern Economic Journal, Vol. 36, June, 1970.

29. Mundlak, Y. : "Empirical Production Functions free of Management Bias" Journal of Farm Economics, Vol. 43, 1961.

30. Mureithi, L.P. : "Elasticity of Substitution, Returns to Scale and Firm Size: An Analysis of Kenyan Data," Eastern Africa Economic Review, Vol.5, 1975.

31. Murray, P.E.: "On the Theory and Measurement of Technological Change" Cambridge University Press, 1968.

32. Nerlove, M.: "Distributed Lags and Demand Analysis for Agricultural and other Commodities," USDA Agricultural Handbook, 141, Washington, 1958.

33. ——— : "The Theory and Empirical Analysis of Production, NBER Studies in Income Wealth, Vol. 31, 1967.

34. ——— : Estimation and Identification of Cobb-Douglas Production Function: McNally and Co - Chicago, 1965.

35. ——— : "Estimates of Elasticities of Supply of Selected Agricultural Commodities, "Journal of Farm Economics, Vol. 38, pp 496-509, 1959.

36. ——— : Distributed Lags and Demand Analysis for Agricultural and other Commodities; USDA Agricultural Handbook, 141, Washington, 1958.

37. Phelps, E.S. : "Constant Categories and the Total Cost Function," Econometrica, Vol.4, pp 224-263, 1936.

19. House, W.J. "Wages, Employment and Productivity in Kenyan Small Scale Industry: Further Evidence," Eastern Africa Economic Review, Vol. 5, No.1 June, 1973.

20. Johnston, J.: "Statistical Cost Functions: A Re-Appraisal," The Review of Economics and Statistics, Vol. 40, 1958.

21. Klein, L.R. : "MacroEconomics and the Theory of Rational Behaviour," Econometric, Vol.14, pp 93-108, 1946.

22. ——— "Remarks on the Theory of Investment," Econometrica, Vol. 14, pp 303-312, 1946.

23. ——— : An Introduction to Econometrics London, 1962.

24. ——— : An Estimation of the CES Production Function," International Economic Review, Vol. 8, pp 180-189, 1967.

25. Maitha, J.K.: "Capital-Labour Substitution in Manufacturing in a Developing Economy: The Case of Kenya," Eastern Africa Economic Review, Vol. 5, No.2 December, 1973.

26. ——— : "The Employment Problem in Kenya: Capital-Labour Substitution in the Economy," ILO, Geneva, March 1976, p. 42.

27. ——— : "A Note on Distributed Lag Models of Maize and Wheat Production Response: The Kenyan Case," Journal of Agricultural Economics, Vol.XXV, No.2, 1974.

28. Moroney, J.R.: "Identification and Specification of Analysis of alternative Equations for Estimating the Elasticity of Substitution," Southern Economic Journal, Vol. 36, June, 1970.

29. Mundlak, Y. : "Empirical Production Functions free of Management Bias" Journal of Farm Economics, Vol. 43, 1961.

30. Mureithi, L.P. : "Elasticity of Substitution, Returns to Scale and Firm Size: An Analysis of Kenyan Data," Eastern Africa Economic Review, Vol.5, 1975.

31. Murray, P.E.: "On the Theory and Measurement of Technological Change" Cambridge University Press, 1968.

32. Nerlove, M.: "Distributed Lags and Demand Analysis for Agricultural and other Commodities," USDA Agricultural Handbook, 141, Washington, 1958.

33. ——— : "The Theory and Empirical Analysis of Production, NBER Studies in Income Wealth, Vol. 31, 1967.

34. ——— : Estimation and Identification of Cobb-Douglas Production Function: McNally and Co - Chicago, 1965.

35. ——— : "Estimates of Elasticities of Supply of Selected Agricultural Commodities, "Journal of Farm Economics, Vol. 38, pp 496-509, 1959.

36. ——— : Distributed Lags and Demand Analysis for Agricultural and other Commodities; USDA Agricultural Handbook, 141, Washington, 1958.

37. Phelps, E.S. : "Constant Categories and the Total Cost Function," Econometrica, Vol.4, pp 224-263, 1936.

1.10 EMPLOYMENT AT THE FACTORY LEVEL.

We have mentioned in the Abstract of this paper that about 30,000 people find employment in cane production and marketing networks at the farm level in the Lake Basin. Most of these people are indeed the local people of the areas in which the factories are established. However, the wages earned by the farm workers are so low that the employment created by these sugar schemes does not significantly change the average income position of the people. The more meaningful employment created by the factories is that which offers permanent employment to about 10,000 people in the sugar factories. Those people earn reasonably high incomes which leave them better off than they would be if they earned the same incomes in the urban centres.

If the establishment of the sugar industries in the rural areas amounts to "taking development to the people" in an effort to alleviate poverty in the rural areas then something should be done to ensure that the local people in the areas where the sugar schemes are established are given first priority in the high income job opportunities in the sugar factories. We realize that some of the sugar schemes carry with them capital investment brought by foreigners who want their dollars back as fast as possible so that employment in the factories should be given a national outlook. But we do not hesitate to point out that the sugar schemes will have served their purpose if only they can improve vertical mobility of labour in the local areas through training. We are not convinced that jobs like agronomy, outgrowers' management, farm machinery maintainance etc, should permanently import personnel from other districts or other provinces because these are skills which can be acquired very easily within a reasonably short time of training in national or international institutions.

"Taking development to the people" should carry with it a whole package of opportunities which are aimed at improving the socio-economic well-being of the local areas and the sugar schemes are traditionally looked at in this sense. We are not supporting increased job opportunities for the local people in total disregard of efficiency and productivity. We are only emphasizing the fact that the Lake Victoria Basin Development Authority comes within the context of Regional Development and as such any national considerations are completely out context with the long-term objectives of the Authority. Of course, in the immediate-run it may be that there are no qualified agriculturalists, engineers and other people like that in a local

area in which a sugar scheme is established and it is inevitable to have a wider outlook in employment. This should, however, be only a temporary measure while the local people are being equipped with the necessary skills.

1.11. CONCLUSIONS AND POLICY IMPLICATIONS.

(A) This paper has established that "factor proportions" problem is not a major stumbling block in the Lake Victoria Basin sugar industry. The fact that elasticity of substitution between capital and labour is greater than Unity in all the four zones studied provides an empirical evidence that the Lake Basin sugar industry has considerable substitution possibilities between capital and labour. What we can derive from this is that employment in the sugar industry could be increased considerably by discouraging any agricultural policies deliberately aimed at making farm machinery and other labour-displacing inputs cheaper in relation to farm wages. That is to say, the Lake Victoria Basin Development Authority should guard against galloping mechanization in the sugar industry, which could easily lead to the displacement of labour and socio-economic losses. This could be done by providing guidelines for application of mechanical devices. Any move towards mechanization of harvesting, loading and delivery of cane to the factories as is currently the practice in most sugar producing countries (ILO, 1970, p.71) should be greatly discouraged because it would not be in line with the resource endowments of the Lake Victoria Basin. The system of labour subcontracting should be abolished or subject to strict statutory regulation instead of leaving workers at the mercy of labour contractors.

In terms of relative income shares of factors of production, high elasticity of factor substitution as established for the sugar industry implies that the relative income share of labour would be reduced if the level of wages were left to increase in relation to the real cost of farm machinery and chemical weed killers. The collective negotiation of farm wages between the Kenya Union of Sugar Plantation Workers (KUSPW) and the Federation of Kenya Employers (FKE) should take this into consideration, because any unproportionate increases in farm wages would simply lead to a trade-off between high incomes to a few farm workers and low income hshare of labour in the industry. While a few farmers in the Lake Basin have complained about seasonal labour shortages during peak periods, the problem does not have as much to do with peak labour shortages as it has to with lack of incentives for horizontal labour mobility within the Lake Basin. There may be peak labour shortages in some parts of the basin while at the same time there is a substantial amount of idle labour in some other parts of the basin. What

is required is a system that can increase horizontal labour mobility in the basin by working out proper standards for housing and water supply in the sugar schemes so that labour can move more willingly into the sugar schemes to reduce the seasonal labour problems.

(B) With respect to the degree of returns to scale and cost structure, the evidence is that cane production is characterized by diseconomies of scale - a fact which calls for a close scrutiny of the present average farm size distribution particularly in the typical large-scale farm zones of Miwani and Chemelil. Appropriate expansionary policy in the industry should emphasize the multiplication of small-scale sugar cane farms to reduce the severity of diseconomies of scale. Recently there have been talks about restricting cane production through a production quota licensing system (a move which is totally unnecessary for a commodity like sugar for which we still have substantial market potential both locally and internationally). Even if such a need arose in future, the licensing system should be biased in favour of multiplication of small-scale farm units in the industry rather than granting monopoly power to a few extremely large farms which we have shown to be a likely source of production inefficiency in the industry. Furthermore, it is our contention that by shaping the pattern of agricultural modernization and the distribution of rural incomes, the farm size distribution is the principal determinant of the composition of intersectoral commodity flows. By giving access to an increasing number of small-scale farmers to monetary agriculture, we shall be creating a much bigger market for industrial commodities than would exist if rural incomes were concentrated in the hands of only a few large-scale farmers.

(C) With respect to price-elasticity of supply, the evidence is that the Lake Basin sugar cane growers are very highly responsive to the price indicator. ForKKenya to achieve and sustain self-sufficiency in sugar production she will have to provide appropriate price incentive to cane growers because increases in prices of other commodities will make it very difficult for the country to sustain self-sufficiency unless cane prices are increased sufficiently to keep cane production at a comparable level with other farm enterprises. One might be tempted to think that cane farmers are happy with the present price of cane because the country has been approaching self-sufficiency in sugar production at a much faster rate in the recent years. It is, however, our contention that the rate of expansion of sugar production in the Lake Basin has simply been imposed by the Government and it does not reflect a natural responsiveness of cane growers to the price

indicator because cane prices have remained low in relation to prices of other commodities like coffee, maize and horticultural crops. Such an expansionary scheme can work only in the short-run before farmers become fully aware of the more profitable farm enterprise alternatives they have.

(D) While all appears not to be too bad with respect to cane production at the farm level, a lot is still left to be desired about the appropriateness of the present technology of sugar manufacture and the kind of cane production organizations that it calls for in the Lake Victoria Basin. It is our contention that the process of industrialization in the sugar industry appears to be fraught with problems and mistakes which relate to selection of inappropriate technology in the sugar manufacturing process. The existing sugar manufacturing technology is necessarily associated with large-scale farming. The enormous scales of existing factories imply that a large area surrounding each factory must be devoted exclusively to cane production and yet the low cane proceeds imply that outgrowers cannot exist on their cane income alone without growing their own basic subsistence commodities. Most factories insist that a farmer must provide a minimum of 5 acres of land for cane cultivation before the farmer can be registered as a supplier of cane. Since this is almost the average land per family in most sugar schemes, it means thataafter getting involved in cane production, a farmer has to rely entirely on what he gets from that enterprise to provide for himself and his family. The minimum acreage requirement has led to the pooling of land in most areas (particularly in the relatively new sugar schemes of Mumias, Nzoia and South Nyanza). Some factories also insist that they have to provide all the cane production services to individual outgrowers and that any outgrower who cultivates cane in his own way cannot be granted the right to deliver cane to the factory. Although the legal notices of private land ownership are preserved in the pooling system, the actual effects of the system are the same as if outgrowers are forced to lease their land to the sugar factories and had little further involvement with it. It would be economically and socially more satisfying if the smallholders owned and cultivated their own land so as to provide for their basic subsistence needs than even the same number of smallholders earning the same total income by working on large-scale farms and factory nucleus estates. The sugar schemes are meant to create gainful employment and the pooling of land so as to mechanize cane production goes contrary to this goal. The smallholders should be made to participate actively on their own small plots.

(E) It has been argued that because of the need for a steady inflow of cane into each factory, the alien organizations controlling the factories must be given control of a large proportion of cane production in the form of factory nucleus estates (see Table 1). On the basis of the yield performance and further statistical evidence in section 1.8, we have shown that this arguement deserves no support because the outgrowers have always been the main suppliers of cane to the factories. Further expansion in the industry should abolish the idea of nucleus estates because they simply increase the sense of alienation of the local people from an enterprise in which they earn their livelihood.

(F) The Kenya Government has stated clearly in the current development plan that it is anxious to avoid centralization of industrial activities in one or two favoured localities. Large-scale sugar factories have therefore been supported on the grounds that they must be located in cane-growing areas rather than sugar consuming areas of the country, and will therefore contribute to decentralization of industry. But one obvious fact is that such large-scale factories are bound to be few in number and therefore have their own centralizing effect. We simply seem to have a total transfer of technology and factory capacities from major sugar-producing countries like Cuba, Brazil, India and Phillippines without a careful look at our resource endowments. It is our contention that smaller sugar factories well distributed in the potential cane growing areas are more appropriate for decentralization of industry unless we can be convinced otherwise that there are substantial economies of scale in the sugar manufacturing process.

(G) Kenya is obviously becoming self-sufficient in sugar production and she will have substantial exportable surpluses by the year 1983. But we do not see the country exporting sugar competitively until domestic sugar prices have been reduced to the international level. Furthermore, no studies have been carried out to establish how much sugar Kenya will be able to export if domestic prices are reduced to the international level. We therefore recommend that a thorough market research be carried out for Kenya's sugar exports. But our immediate concern should be with the disposition of the surpluses that will build up from 1983. One immediate solution is to reduce domestic price of sugar so as to increase domestic households' consumption of this important source of energy. This will call for immediate removal of the unnecessary levies currently imposed on the commodity and a review of the margin allowed to sugar factories. At a later stage, some serious technical research should be carried out to provide greater production efficiency. Finally, some research

should be carried out to establish ways of increasing industrial use of sugar so that Kenya can produce refined sugar.

There is still no need to restrict domestic production of sugar because the unfulfilled domestic demand is quite substantial. The quota licensing system can wait for a more opportune time.

To conclude, we say that Kenya desparately needs foreign exchange and being self-sufficient in sugar production is vital to the preservation of foreign exchange. However, production is very much an economic phenomenon and to set production goals without appropriation production incentives at the farm level is to do the wrong job. Only a carefully planned and consistent pricing and marketing policy can achieve the stated production targets. Carefully formulated factor pricing policy could greatly increase the relative share of labour in total output. There is an urgent need to review the present Government policy in relation to the establishment of large factories with capacities which encourage cane production organizations which are inappropriate to the country's economic situation.

BIBLIOGRAPHY

1. Ady, P "Trends in Cocoa Production," Bulletin of the Oxford University Institute of Statistics, Vol. 2, pp 389-401, 1949.

2. Arrow, K.J. Chenery B.S., Minhas and Solow, R.M.: "Capital-labour Substitution and Economic Efficiency," The Review of Economics and Statistics, 1961.

3. Baterman, M.J. "Aggregate and Regional Supply Functions for Ghananian Cocoa," Journal of Farm Economics, Vol.47 pp 384-401.

4. Baver, P.T. and Yamey, B.S.: A Case Study of response to Price in an Underdeveloped country," Economic Journal, Vol.69 pp 800-805, 1959.

5. Berringer, C. Estimating Enterprise Production Functions From Input - Output Data on Multiple Enterprise Farms," Journal of Farm Economics, Vol. 38, pp 923-930, 1956.

6. Dean E: "Economic Analysis and African Response to Price," Journal of Farm Economics, Vol. 47, pp 402-409, 1965.

7. ———— The Supply Responses of African Farmers: Theory and Measurement in Malawi. North-Holland Publishing Co, Armsterdam, 1966.

8. Drake, L.S. "A Method of Showing Farmers how to Estimate Gross Income and Marginal Productivity" Journal of Farm Economics, Vol. 36 pp 66-77, 1954.

9. Drymes, P.J. "Same Extensions and Tests for the CES class of Production Functions" The Review of Economics and Statistics, Vol. 47, Nov. 1965.

10. Enke,: "Production Functions and Capital Depreciation, "Journal of Political Economy, Vol. 70, pp 368-379, 1962.

11. Eherington, D.M.: An Econometric Study of Smallholder Tea Production in Kenya. Ph.D. Thesis, Stanford University, 1970.

12. Griliches, Z: "Specification Bias in Estimates of Production Functions," Journal of Farm Economics, Vol. 39, pp 8-20, 1957.

13. Gwayer, G.D.: "Long-and Short-Run Elasticities of Sisal Supply," Eastern Africa Economic Review, December 1971.

14. Harris, J.R. and Todaro, M.P.,:"Wages, Industrial Employment and Labour Productivity: The Kenyan Experience," Eastern Africa Economic Review, Vol. 1 No.1, June 1969.

15. Hawtrey, R: "Production Functions and Land: A New Approach" Economic Journal, NVol. 70, pp 114-124, 1960.

16. Heady, E.O. and Dillon, J.L. : Agricultural Production Functions, Ames 1962.

17. Heady, E.O. Johnson G.L. and Hardin, L.S.: Resource Productivity, Returns to Scale and Farm Size, Ames, 1956.

18. Henderson, J.M. and Quandt, R.E.: "Microeconomic Theory: A Mathematical Approach. McGraw Hill Book Co. Inc.

19. House, W.J. : "Wages, Employment and Productivity in Kenya: Some Further Evidence, "Eastern Africa Economic Review, Vol. 5, No.1 June, 1973.

20. Johnston, J.: "Statistical Cost Functions: A Re-Appraisal," The Review of Economics and Statistics, Vol. 40, 1958.

21. Klein, L.R. : "MacroEconomics and the Theory of Rational Behaviour," Econometric, Vol.14, pp 93-108, 1946.

22. ———— "Remarks on the Theory of Aggregation," Econometrica, Vol. 14, pp 303-312, 1946.

23. ———— :A Textbook of Econometrics Evanston, 1953.

24. ———— :An Introduction to Econometrics London, 1962.

25. Kmenta, J. "An Estimation of the CES Production Function," International Economic Review, Vol. 8, pp 180-189, 1967.

26. Maitha, J.K.: "Capital-Labour Substitution in Manufacturing in a Developin Economy: The Case of Kenya," Eastern Africa Economic Review, Vol. 5, No.2 December, 1973.

27. ———— : "The Employment Problem in Kenya: Capital-Labour Substitution in the Economy," ILO, Geneva, March 1976, p. 42.

28. ———— : "A Note on Distributed Lag Models of Maize and Wheat Production Response: The Kenyan Case, "Journal of Agricultural Economics, Vol.XXV, No.2, 1974.

29. Moroney, J.R.: "Identification and Specification of Analysis of alternative Equations for Estimating the Elasticity of Substitution," Southern Economic Journal, Vol.36, January 1970.

30. Mundlak, Y. : "Empirical Production Functions Free of Management Bias" Journal of Farm Economics Vol.43, pp 44-56, 1961.

31. Mureithi, L.P. : "Elasticity of Substitution, Returns to Scale and Firm Size: An Analysis of Kenyan Data", Eastern Africa Economic Review, Vol.5, 1975.

32. Murray, B.: On the Theory and Measurement of Technological Change, Cambridge University Press, 1968.

33. ———— : "The Theory and Empirical Analysis of Production", NBER Studies in Income Wealth, Vol. 31, 1967.

34. Nerlove, M.: Estimation and Identification of the Cobb-Douglas Production Function: McNally and Co - Chicago, 1965.

35. ———— : "Estimates of Elasticities of Supply of Selected Agricultural Commodities, "Journal of Farm Economics, Vol. 38, pp 496-509, 1959.

36. ———— Distributed Lags and Demand Analysis for Agricultural and other Commodities; USDA Agricultural Handbook, 141, Washington, 1958.

37. Phelphs, B.E.H.: "Cost Categories and the Total Cost Function," Econometrica, Vol.4, pp 224-263, 1936.

38. Ramsey, J.B. and Zerembka, P. "Specification ERROR, Tests and Alternative Functional Forms of the Aggregate Production Function," Journal of the American Statistical Association, Vol. 66, No.335, September 1971.

39. Revankar, N.S. : Production Functions with Variable Elasticity of Substitution and Variable Returns to Scale Discussion Paper No. 7, Department of Economics, State University of New York, Buffalo.

40. Sato, R. and Floffman: "Production Functions with Variable Elasticity of Factor Substitution: Some Analysis and Testing." The Review of Economics and Statistics, Vol. 50, pp 453-460, 1968.

41. Soskice, D. : "A Modification of the CES Production Function to allow for Changing Returns to Scale Over the Functions." Review of Economics and Statistics, Vol. 50, pp 446-448, 1968.

42. Tintrer, G. :"A Note on the Derivation of Production Functions from Farm Farm Records." Econometrica, Vol. 12, pp 226-241, 1936.

43. Tintrer, G. and Brownlee, O.H. : "Production Functions Derived from Farm Records." Journal of Farm Economics, Vol. 26, pp 226-341, 1944.

44. Tweddle, W.A. and Stone, R. : "A Study of Costs," Econometrica, Vol. 4, pp 226-241, 1936.

45. Walters, A.A. : "Production and Cost Functions an Econometric Survey," Econometrica, Vol.31, January 1963.

46. Wolfson, R.J. : "An Econometric Investigation of Regional Differentials in American Agricultural Wages," Econometrica, Vol. 26, pp 225-257, 1958.

47. Yao-Chi Lu and Fletcher, L.B.: "A Generalization of the CES Production Function," The Review of Economics and Statistics, Vol. 50, pp 449-452, 1968.

48. Zellrer, A. : "An Interesting General Farm for a Production Function," Econometrica, Vol. 19, pp 188-189, 1951.

COTTON PRODUCTION AND MARKETING IN THE LAKE VICTORIA BASIN OF KENYA.

By

D.A. Obara
Department of Geography
University of Nairobi

INTRODUCTION:

Owing to the fact that agriculture is the mainstay of the economy of Kenya, it is the Government's policy to encourage commercial farming with the hope that this would lead to increased income, foreign exchange earnings, employment opportunities, industrialization and improvements in standards of living in the rural areas. Similarly, it is the Government's policy to encourage the expansion of cotton production as an important element in increasing the income of some of the underprivileged farmers in the country (Republic of Kenya, 1970). Currently cotton is grown in many parts of the country (Fig. 1) under three main systems: individual small-scale farming, group farming on large blocks and irrigation schemes. These systems are examined in detail later on in the present paper in order to show the merits of each. Cotton could offer potential for industrialization and employment opportunities in the Lake Victoria Basin where cotton textile factory (KICOMI) now exists, provided more incentives are given to the farmers by increasing producer prices, improving marketing system and providing credit and subsidizing the prices of inputs.

Before independence the Lake Victoria Basin was the major source of cotton in the country. Even after independence the region still continued to supply approximately 50-65% of the national output of this industrial crop. Because of the ecological potential of the region, the current Government's policy is to expand cotton production in the Lake Victoria Basin. However, the output levels will also increase through the improvements of yield expected from the extension programme, Government mechanized ploughing services, payment without delay, provision of storage and transport facilities in the cotton growing areas (Republic of Kenya 1979). With such an ambitious policy, the government aims at increasing cotton production and to achieve self-sufficiency for domestic textile production. This aim can only be achieved if and only if cotton production in the country increases at a rate of 11.4% from 15,800 tonnes in 1976 to 34,000 tonnes in 1983. Despite this projected rate of cotton production, a number of problems still remain to be resolved in most cotton growing areas, especially, the Lake Victoria Basin, before increased cotton production can be realized. The previous and current Government's policies have not sufficiently emphasized the need to examine cotton production

problems in the context of the wide variety of ecological conditions that prevail in the Lake Victoria Basin, or to consider the environment under which small-scale cotton farming operates. Unless measures are taken to alleviate ecological and socio-economic constraints in the region, increased cotton production may not materialize. In view of these problems, the main objectives of the present paper are:-

1. To show the significance of cotton in the economy of Kenya.
2. To give an overview of the origins of cotton and research development in the Lake Victoria Basin.
3. To discuss the morphology and development of the cotton plant in order to streamline future research needs.
4. To examine the environmental requirements for cotton production in the region.
5. To discuss the different cotton farming systems.
6. To give a historical perspective of cotton production in the Lake Victoria Basin.
7. To provide a basic understanding of some of the problems of cotton production and marketing.
8. To examine the Government's price policy on Cotton production.
9. To give recommendations for policy implications.

SIGNIFICANCE OF COTTON IN THE ECONOMY OF KENYA.

Cotton is probably the most important fibre in the World. The main drawback of the crop in economic development terms of Kenya stems from the expansion of the use of imported synthetic fibres, for example, nylon and its derivatives from developed countries. However, imposing higher import duties on imported textiles by the Government is likely to stimulate cotton production. The crop is grown in Kenya chiefly for its fibre which is used in the textile industry for the manufacture of cloth, blanket, thread and surgical lint. Apart from these uses, low-grade fibre, waste products and fuzz are consumed in the production of felts or batting used in mattresses and other bedding products and in upholstery for furniture. In other countries, lower quality cotton is used as a raw material in the manufacture of high-grade writing paper and rayon and in the chemical industry, for making photographic and X-ray films.

One of the several by-products that represent a large part of the value of the crop is cotton seed. The major products of cotton seed are: cotton seed oil, cake and meal, cotton seed hulls and linters. The cotton

seed is cleaned, crushed and subjected to high pressures to extract oil. The oil is the most valuable of the four products, accounting for 50-55% of the value of all of them (Berger, 1969). Cotton seed oil has approximately the same composition as olive oil and is used for cooking manufacture of salad oils, soap, paints, deomargarine, mayonnaise and lubricants.

The second most valuable product is cotton cake or meal. The cotton seed cake is processed into seed meal which is a valuable stock food in Kenya. The meal makes a highly concentrated feed that contains 36-41% protein and 5-7% fat (Kipps, 1970). This is confirmed by Ngugi, et at (1978) who mentioned that undercorticated cotton seed cake contains about 21% protein, while the decorticated cake contains about 36% protein. It is largely prized as cattle feed and is used to some extent for horses and sheep. The cotton seed meal is used in the manufacture of feeds for monogastric animals like pigs and Poultry (Baustad, 1974). Nevertheless, it is toxic to hogs and will cause death if fed in large quantities. It also causes digestive disorders in poultry and young animals when fed in large quantities. High-grade cotton seed contains 6% nitrogen, 3% phosphoric acid, and 2% potash and is used in considerable quantities in the fertilizer industries, particularly when cattle feed are cheap.

Cotton seed hulls are the least valuable of the four main products from cotton seed. Like meal, they are used almost entirely as a low-grade carbohydrate roughage for cattle and to some extent in the manufacture of paper, fibre-board, synthetic rubber, lubricating oils,fertilizers and certain types of plastics. Linters, on the other hand, have a wider variety of uses than any of the three cotton seed products already discussed. They are used in manufacturing rayon, explosives film, shatter-proof glass, plastics and scores of other items. A part from these uses of cotton, a contraceptive pill has recently been made from cotton seed and used successfully in China, thus widening the market for this commodity.

Moreover, dry cotton stalks are burnt by the local people in cotton growing areas to provide energy for cooking. Unlike most of the cash crops grown in the Lake Victoria Basin, cotton is capable of providing all the three basic necessities of life: food, clothing and shelter. The development of cotton in the Lake Victoria Basin should not be frustrating since it has multiple uses, which may be regarded as insurance for its increased consumption in the country, and elsewhere in the world.

PHYSICAL FEATURES

Fig. 4

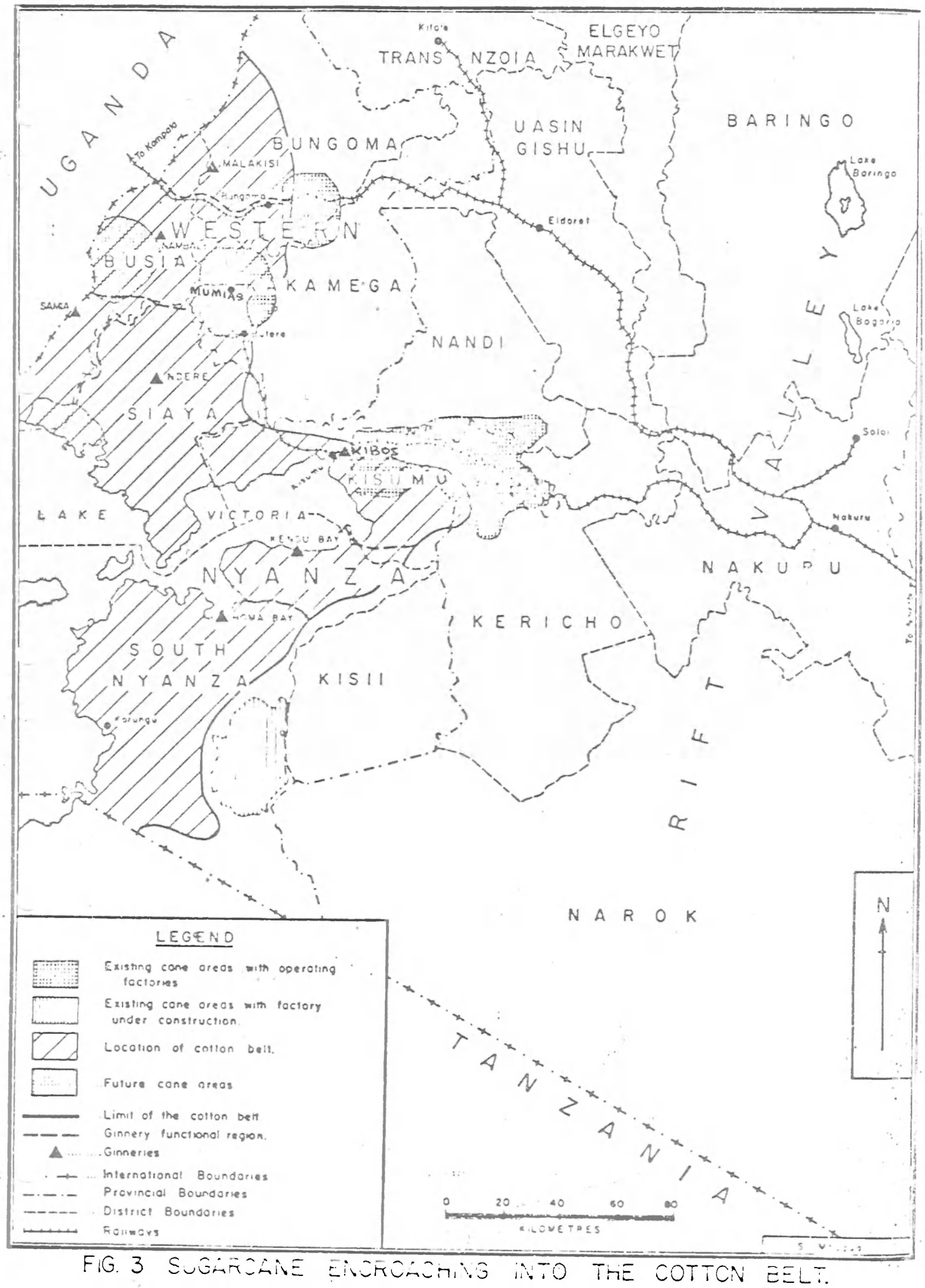


FIG. 3 SUGARCANE ENCROACHING INTO THE COTTON BELT.

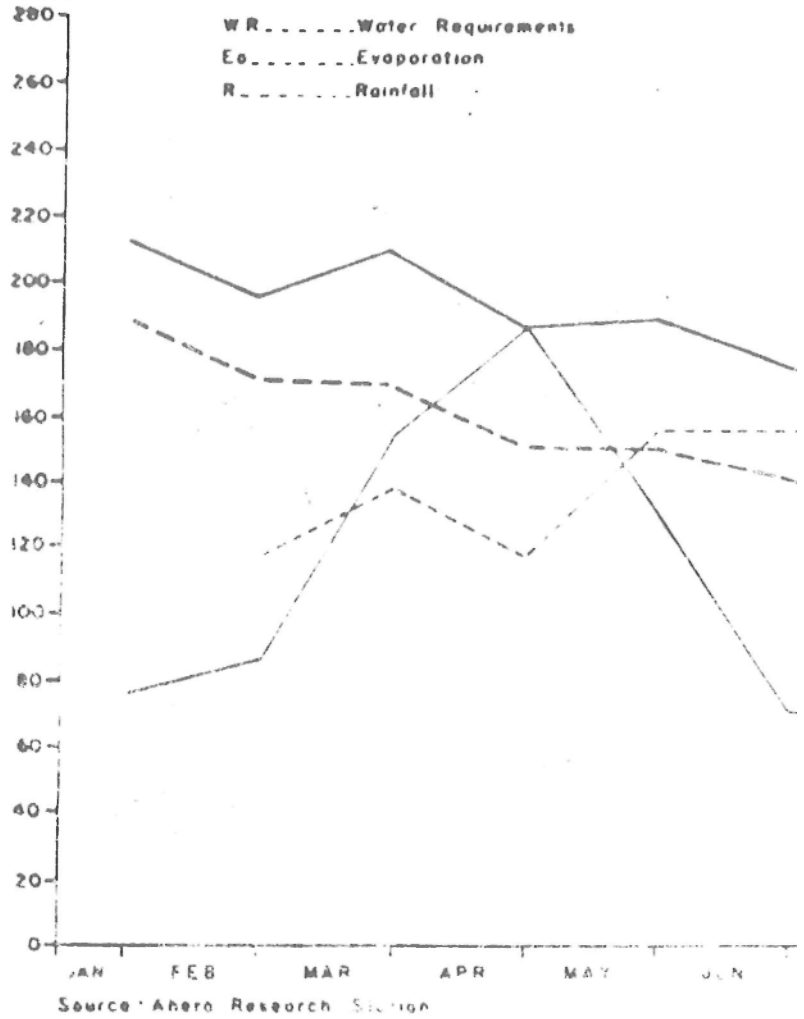
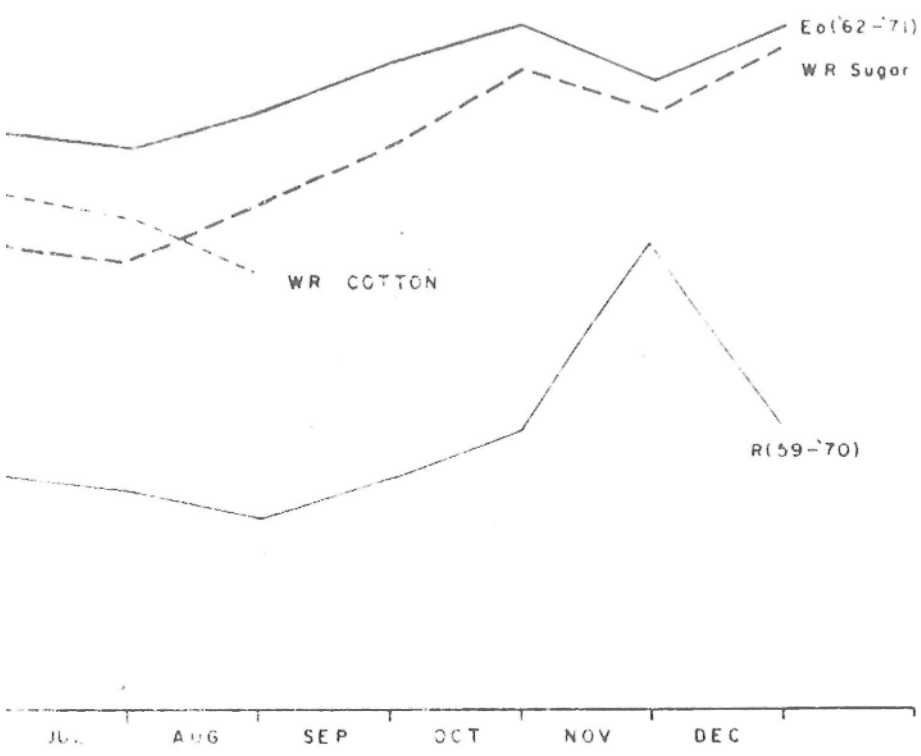


FIG.4 RAINFALL, EVAPOR[illegible] AND



WATER REQUIREMENTS (For cane & cotton) AT AHERO

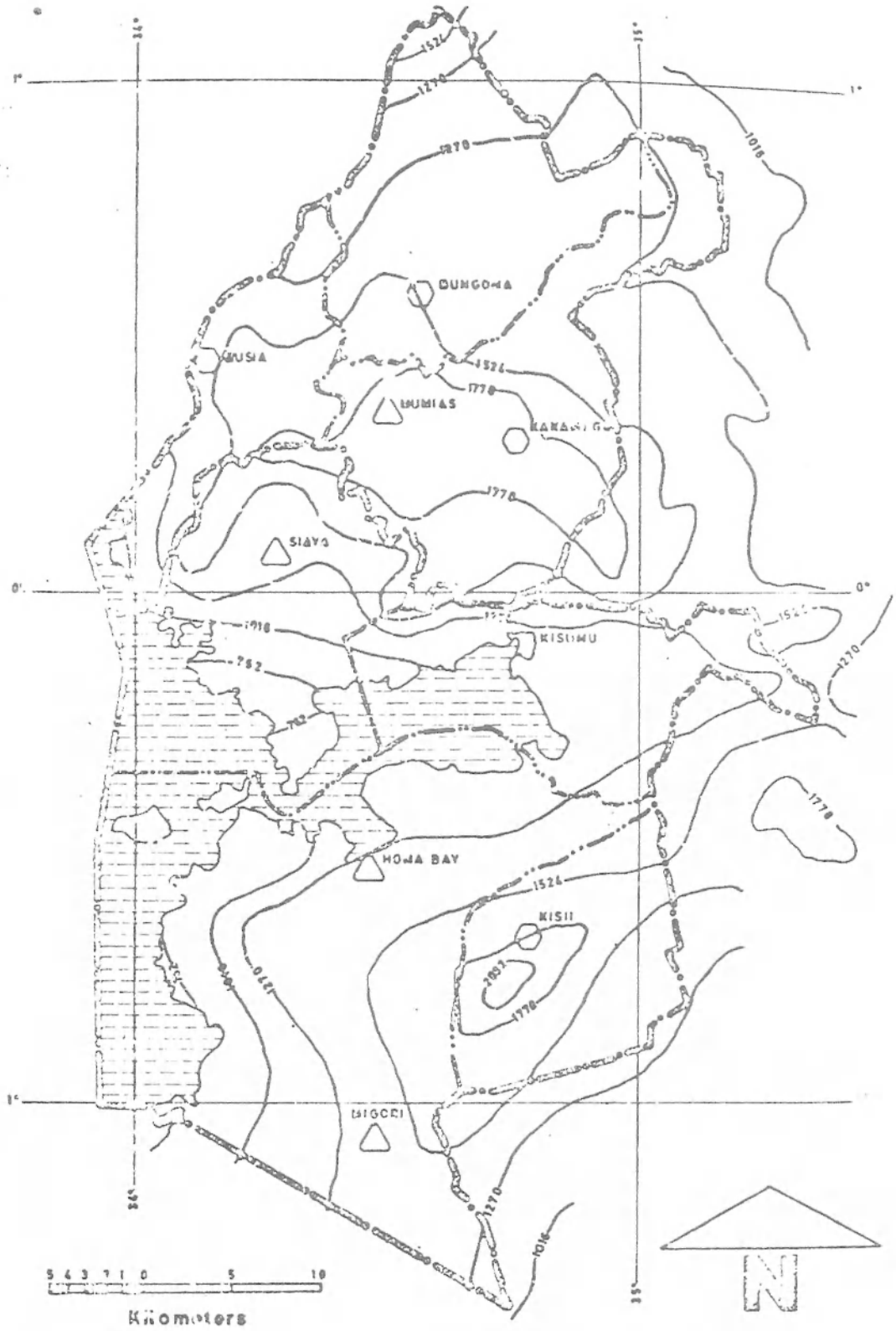
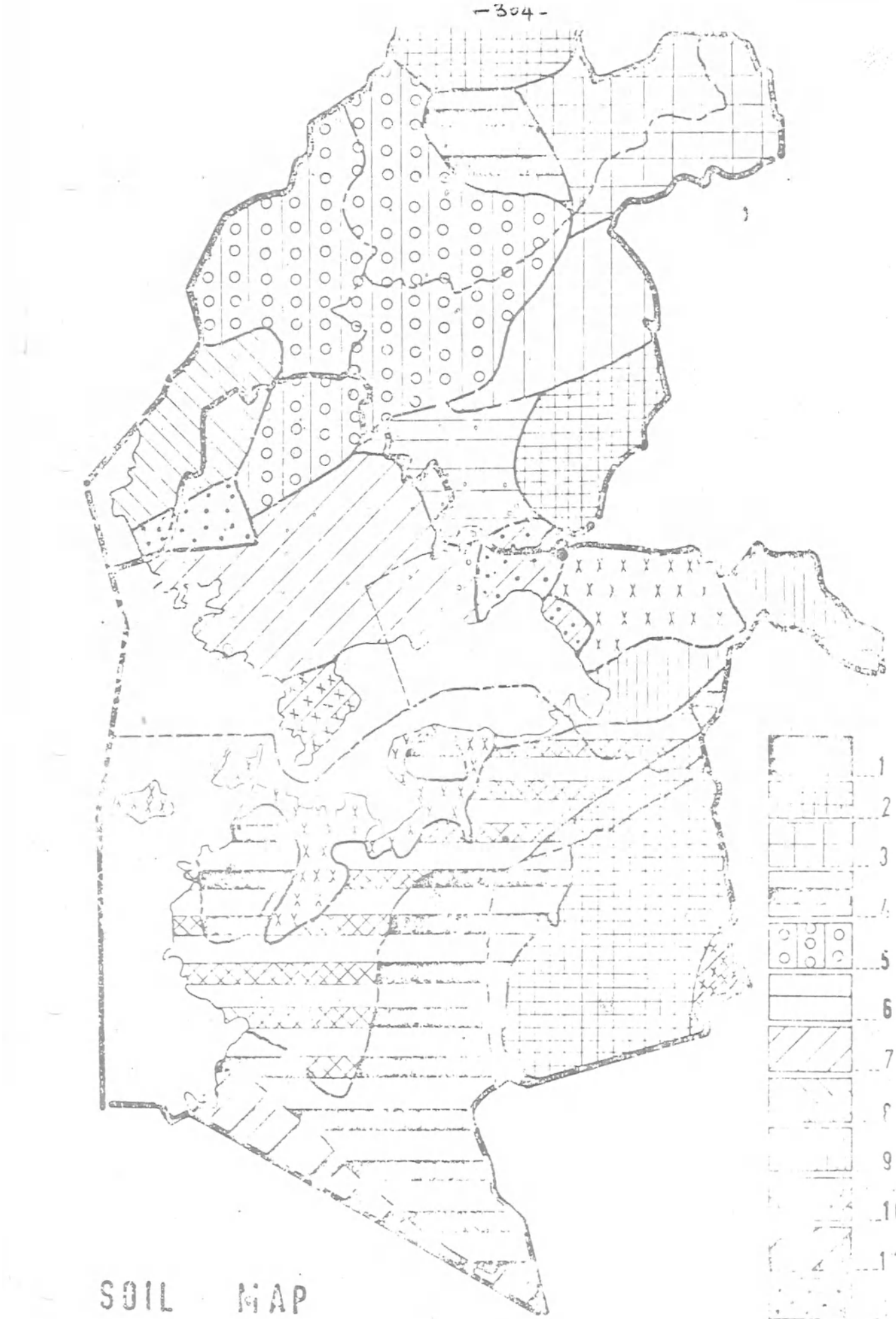


Fig. 5 MEAN ANNUAL RAINFALL



SOIL MAP

FIG. 6

PUBLIC INTEREST AND PRIVATE BENEFIT IN LAND USE POLICY : AN ENQUIRY INTO SOME SOCIETAL AND LAND USE ISSUES IN THE LAKE VICTORIA BASIN

By

H.W.O. Okoth-Ogendo
Faculty of Law
University of Nairobi.

INTRODUCTION

A: The Scope of Enquiry

Development Authorities such as the one envisaged for the Lake Victoria Basin are usually set up only if a particular economic activity cannot be efficiently undertaken without state control of the resources that are the basis for that activity. In other words there must be good reason for thinking either that individual enterprise per se is not efficient that public policy demands that the management of the resources concerned be turned over to state agencies. That, at least, is the theory of the case in all free enterprise economies and in Kenya as well.

Experience with the control structures that are commonly suggested for, the modalities and actual performance of Development Authorities the world over, indicates, however, that they are never meant and cannot in fact completel supercede individual enterprise. Rather, what they do is to transform the nature of individual participation in the enterprise. In other words the primary concern of Development Authorities is to organise and control individual or collective enterprise in such a way as to enable the people involved to derive the maximum possible benefit from the resource base concerned. If it is the case, therefore, that Development Authorities are, strictly speaking, only agencies for efficient management of public resources, the question that arises is this: what then is the correct balance between public interest and private benefit in the operation of such authorities? This paper is an attempt to enquire into the nature and dynamics of that inter-section. In particular, I wish to anticipate some of the land tenure and use problems which are likely to arise in an attempt to develop the Lake Victoria basin through the instrument of the model contained in the Lake Basin Development Authority Act 1979.

B: The Evolution of Development Authorities in Kenya

Development Authorities are not a new phenomenon in Kenya. One of the earliest of them was the Development and Reconstruction Authority (DARA) set up in 1946 to administer funds voted by the colonial government for the rehabilitation and restoration of eroded, over-grazed and allegedly mismanaged land in the African "reserves". DARA was not set up by legislation. It was simply an administrative instrument of the Department of Agriculture set up to undertake specific tasks with the collaboration of administrative personnel in the office of the Chief Native Commissioner and an African Land Utilisation and Settlement Board (ALDEV REPORT 1946-62). Most of DARA's Activities went into bush clearing, terracing, strip cropping, water furrows and systematic culling and destruction of "unwanted animals". Although none of these activities were entirely successful, in DARA was the germ of a control and regulatory structure which continues to characterise what are described below as "liason authorities" as opposed to "Development Authorities" s ricto sensu. This is that DARA had no authority to undertake projects directly. As such its role was purely regulatory at best and merely to provide finance at the v ry worst.

With independence the concept and functional role of development authorities were expanded to include not only liason but truly management and executive dimensions. This was particularly the case with development authorities set up under the Agriculture Act (Cap. 318, Laws of Kenya) such as the Kenya Tea Development Authority (KTDA), the Coffee Development Authority (CDA) the Pineapple Development Authority (PDA) the Kenya Sugar Authority (KSA) and the Horticultural Crops Development Authority (HCDA). The main difference between these particular authorities and DARA, and others established by legislative action after independence such as the Tana River Development Authority (TRDA) was that the former unlike the latter were tied down to the management and development of clearly defined agricultural undertakings. Their functions were couched in clearly managerial terms and their powers sufficiently wide to permit strong executive action. But therein was a new dimension which DARA did not quite have but which development authorities established under the Agriculture Act shared with the TRDA. This was a top-heavy and overly bureaucratised control structure. The justification that was given for this structure was that strong central direction was necessary if these parastatals were to discharge their functions speedily, efficiently and in the national interest.

It may thus be stated that by the time the Lake Basin Development Authority (LBDA) was being set up, two possible structural options were available One was to establish a "liason" authority or a truly "executive" one. A third option was one that combined these two thus allowing for the possibility of a fairly comprehensive organisation. The structure that has been adopted for the LBDA appears to have been a very pale version of the third option. For while, the control structure of the proposed Authority is clearly modelled on the bureaucratic formula upon which the Cap. 318 authorities and TRDA were based, its functions are predominantly liason in character and only marginally regulatory in a management sense. Indeed in the tradition of DARA and TRDA, the LBDA seems not to have been intended to do anything more than the co-ordination of agencies already operating in the Lake Basin.

C: Development Authorities and Social Change

The mere fact that an authority exists where there was none before is however, an important variable in the socio-economic life of the people within its area of jurisdiction. This is the case whether the authority is designed to operate mainly as a liason agency or as an executive and functionally independent body. For whether it acts directly or indirectly projects will be identified and executed, existing land use systems may become modified or even superceded and ultimately social organisation within the authority's area of jurisdiction cannot escape transformation. For authorities of the first kind, the problem that arises is tnat they are not often in a position to control the activities of the agencies through which they operate and consequently may not be able to handle the impact of such activities on local society. This has happened in the case of irrigation and hydroelectric power schemes undertaken on behalf of TRDA by the National Irrigation Board and the Kenya Power Company respectively. In both cases widespread relocation of indigenous populations have been the rule; the consequences being massive social disruption, precarious alternative land use systems and ultimately little benefit to the people involved.

For authorities of the second kind, direct involvement means that effects of specific projects or of executive decisions they make can easily be monitored. Although remedial action may not always be forth-coming due mainly to the bureaucratic chains through which decisions are processed, the mandate to act is there and if need be can be invoked. Consequently, authorities in this category have been able to integrate their activities with individual effort in a manner that makes state intervention sensible to the people within their areas of jurisdiction. And because these authorities are concerned with specifically designated economic enterprises rather than with amorphously defined geographical

areas, they are much better able to identify the proper points of intersection between public interest and private benefit than the other group of authorities can. This partly accounts for the enormous success which the KTDA and the KSA, in particular, have registered. Where failure or only marginal success has been recorded as in the case of the CDA, this has been because a development authority was unnecessary in the first place rather than that there was fault with the structural model itself.

The point to be emphasised here is that authorities that have to rely on other agencies for executive action are less likely to initiate programmes that are of benefit to local societies than functionally specific and autonomous ones. But the measure and quality of change that the former can effect will ultimately vary not only with the concerns of its various executive agencies; the nature of the schemes they initiate and the resources at their disposal but also with its interraction with the local society at large. In the case of authorities that are designed to revolutionise land use systems, such as the LBDA is by legislation intended to be, the most obvious variables likely to influence the quantum of change they would have include, the nature of existing land use systems in the area, the development goals existing agencies, the political environment and socio-cultural composition of the area, and existing land tenure institutions and settlement patterns. These will now be considered briefly in relation to the proposed LBDA.

D: LBDA and Change in the Lake Basin

Under the 1979 Act the LBDA will be required to undertake two different but highly interrelated tasks. The first is the regulation and control of land use systems along the catchment area of the basin, and the second is the identification and execution (through existing agencies) of specific programmes within those parts of the catchment area (referred to in the Act as the "development area") that are within Western and Nyanza Provinces. The former appear to be the basic rationale for the establishment of the authority whereas the latter appears to be for cosmetic purposes only. This assessment is based partly on our understanding of the various models of development authorities which Kenya has adopted and partly on what seems to have been a deliberate attempt in the Act to deprive the proposed authority of executive functions within Western and Nyanza Provinces. Once this is understood, the impact of LBDA is potentially unlimited outside these provinces while within them its impact cannot be accurately assessed until the authority lends its clout to particular programmes. What is given below is therefore no more than an attempt to predict what the direction of change might be LBDA becomes operational

i) LBDA and Land Use Systems. We start with an assessment of the possible impact of LBDA on existing patterns of land use. Outside the development area LBDA's main concern will be to ensure that agricultural and range management practices in the upper gradients do not lead to indiscriminate destruction of forests and catchment areas, and to soil erosion and excessive silting down-stream. For any of these effects are likely not only to alter the ecological balance of the entire basin area but also to adversely affect programme implementation within the development area. In order to do this successfully, however, LBDA will need not only the co-operation but also the administrative machinery of a large number of field agencies operating within the catchment area. In particular it will have to either set up an inspectorate system to ensure that existing land utilisation rules are in fact followed, or pursuade the state to appropriate buffer zones along river valleys so as to pre-empt destructive land use practices in higher gradient areas. In both cases the potential for conflict between public interest and private enterprise is almost unlimited. In the first instance the encroachment of agricultural land use systems into areas that were formerly forest reserves and protective buffers being in itself a manifestation of increasing land pressure in the highlands, it is not going to be easy to enforce land utilisation rules. This is particularly the case with rules defining what permissible gradients for unterraced cultivation are and those requiring specific percentages of farm land to be preserved as perpetual forests. In the second instance post-independence experience has shown that the field machinery of the state has neither the capacity nor the will to enforce land utilisation rules; these being identified mainly with colonial oppression and regimentation. It is a distinct possibility therefore that LBDA attempts to fulfil its mandate in areas outside Western and Nyanza Provinces may totally fail.

Within the development area, however, the land use problems which LBDA is likely to encounter are rather different. For it is the case, first that existing patterns of land use in this area are the product not only of complex socio-cultural processes, but also of the peculiar ecology of the area; second that state preference in this area is clearly for the expansion of irrigation farming and the development of cane for white sugar production. These two factors alone will reduce the options available to LBDA to projects or programmes intended to facilitate what state agencies are already engaged in. The expansion of irrigation farming, however, will most certainly lead to the elimination of important subsistence activities in the area. For if the experience of the Ahero, West Kano and Bunyala irrigation schemes is anything to go by irrigation will most certainly lead to excessive reliance on a single crop thus making it difficult for societies involved to satisfy other needs. One result in the case of Ahero has been widespread malnutrition and loss of resistance to common

diseases that this entails. LBDA being little more than a liason authority even within the development area, may not be in a position to arrest such adverse effects. This is particularly likely if the National Irrigation Board is used as the primary vehicle for irrigation farming in the area. For the Board, being itself a statutory body, operates within its own rules, defines its own priorities and follows its own administrative style. Any attempt by LBDA to pry into this is not likely to be well received in the NIB bureaucracy. Thus whereas existing land use systems will be adversely affected by the operation of the authority, this is likely to come not directly but via agencies over which it may not have much control.

ii). Development Goals of Existing Agencies and LBDA. The possibility that agencies already engaged in development activities within the jurisdiction of the proposed LBDA may alienate it from local societies, however, is not fully explained by merely looking at the provisions of the 1979 Act. For these agencies namely, the state through its numerous field bureaucracies, the NIB, the commodity boards, the sugar companies under the general umbrella of the KSA, and the farmers individually or through their accredited organisations, to mention but a few, have vested interests in the area which they may not readily want to

These interests are likely to be very parochial but nonetheless of great significance for the rational management of resources in the area. For the first three of these agencies, the interests in question may be rooted in little more than the desire to avoid the possibility of functional redundancy or partial loss of "an empire" as was the case with resistance to the Special Rural Development Programme (SRDP) in the Coast Province; for the sugar factories the relevant interests will obviously be tied to their investment programmes and for the farmers this may have to do with resistance to the uncertainties and risks which a new programme might bring. All of these will mean that the LBDA may for a considerable period of time be able to tackle only peripheral issues within Western and Nyanza Provinces. That the state does not seem to be concerned with this dimension of LBDA planning is particularly disconcerting. For it seems obvious that the goals of these agencies will need to be redifined in the light of the establishment of the authority if the latter is to attain functional maturity in the area. This is a task which the authority itself cannot do even if it had the mandate which it does not appear to have. If this redefinition is to be done at all, and it should, it will have to be done by the state itself.

iii). The Political and Socio-Cultural Framework of LBDA Operation. There is no doubt that the political environment and socio-cultural composition of an area are important considerations in the operation of any development agency. For the LBDA these will include the state of the politics of resource allocation in the area, the political expectations of interest groups there, and the cultural ideology of the people within LBDA's jurisdiction.

Irrespective of whether this can be statistically verified or not, it is the case that Western Kenya as a whole feels that it has not obtained its proportionate share of public resources since independence. And within the region itself public resource allocation has been anything but equitable. Rather the primary determinant of resource allocation has been a complex network of patron client relationships between local politicians and political hopefuls, and control government ministries and agencies. Resource politics in Western Kenya especially in Nyanza has therefore become little more than the politics of patronage and frustration. It is partly for this reason that LBDA is being seen in many quarters in Western Kenya as the antidote for economic maladies of the area. What is likely to happen therefore is that attempts will be made to co-opt LBDA into this complex network. The result of such a situation is certain to be almost endless intra-regional conflict and little development benefit to the area. I can foresee, for example, pressures designed to centralise LBDA activities in Nyanza only; this on the strong belief that the authority was a Presidential "gift" to the area. Within Nyanza itself even more parochial demands are likely to be made. While these pressures must obviously be resisted, they cannot be completely ignored for they are part of the realities of the area.

The cultural ideology of a people i.e. the perspective with which they receive and assimilate strangers, new ideas and institutions will also be an important variable. The choice of personnel to man LBDA will therefore require close scrutiny. What we have in mind here is that attempts ought to be made to minimise social distance between the LBDA team and the local population. This can be done either by insisting on a purely professional cadre, i.e. those with intimate knowledge of the problems of the area and of social and cultural altitudes to them, or by incorporating local institutions into the decision-making processes of the authority. Ideally it may be necessary t strike an operational balance between these two positions if the confidence of the local people is to be won. Experience with development authorities of this kind suggests, however, that they consider an element of detachment from local society as essential for their operation. This is based

on the misguided fear that empathy with the social environment of a people will, ip so facto, lead to the sort of co-optation discussed in the previous paragraph. As a result most development authorities remain abstract entities and for what the local population cares, simply another government. In a much administered society such as Nyanza Province is, the addition of "another government" is unlikely to impress the peasantry.

iv). LBDA and Existing Land Tenure and Settlement Patterns. But perhaps the biggest test for LBDA survival will be the manner in which it handles issues of land ownership, distribution and settlement patterns in the area.

With respect to land ownership and distribution, several issues immediately come to mind given the fact that direct control of some land will be central to most development measures the LBDA may wish to undertake. These are availability of land, the nature of access rights in the Basin, and the state of land reform in the area.

a) Availability of Land. That there is no "empty" or even under-utilized land in the entire basin area is obvious. Indeed, average land sizes range from less than 0.5 hectares in Vihiga in Kakamega District to just over three hectares in parts of Siaya and South Nyanza Districts. This means that whatever land LBDA might need can only be found through the displacement of resident populations. This is the approach which has been used in Nzoia, Mumias and Awendo sugar - belts. The social consequences of this approach are outlined below. What is relevant here is that even if LBDA were to opt for a policy of land as opposed to monetary compensation, population relocation within the basin area would be impossible.

b). Access Rights to Land. Unavailability of land is further compounded by the fact that access rights in the area is still so diffuse and intertwined that it is not always possible to identify who owns what interest in what land. As far as most people in the area especially in the flood plains are concerned, the land remains the common property of all living members of the family and an investment for the benefit of future generations. A description of the structure of access to land in Luo society might help clarify the point. Despite tremendous changes in indigenous land tenure as a result of population pressure and land reform it may still be said that in Luo society acquisition of access rights of whatever category is based strictly on the lineage principle. Even the allocation of lesser rights e.g. customary tenancies, are still based on that principle. For example, in order to be accepted as Jadak,

one has to be adopted by a segment of Luo society, and once adopted, such a person can only be evicted for gross misconduct such as the repudiation of the sovereign authority of the lineage concerned. For all practical purposes land remains held and used as a collective asset by Jokakwaro, a group three to five generations deep depending on the closeness of its members. In former times the common grand-father of this group was recognised as the land controlling authority. He allocated cultivation rights and controlled types and extent of use. Although this control structure has now given way to more necleated forms, functions similar to these are still exercised by extended family heads.

On the death of a lineage member, his access rights passed to his male descendants according to what may be described as the 'house-principle'! In other words, any rights held at death were first divided among the houses of the wives of the deceased if he was a polygamist, and then further subdivided amongst the male descendants in each house. This basically male order of succession follows from the fact that in Luo society as in all patrilineal societies, the burden of ensuring the material survival of the group was always placed on its male and not female descendants. For the latter were and still are not regarded as permanent members of the society of their progenitors. An important consequence of Luo customary rules of succession and one that has been widely misunderstood in the land tenure literature is the fact that continuous parcelation of land became inevitable. In some, although not in all cases, parcelation was also accompanied by fragmentation. This was inevitable given the very wide variation in topography and ecology for which land in the Luo areas is well known. Indeed both parcelation and fragmentation had an important function to play in indigenous tenure. They operated as risk minimising mechanisms especially in areas of micro-climatic variation. Indeed as long as there was no acute land pressure, both parcelation and fragmentation were logical and necessary.

iii). The State of Land Reform. Recent studies made in those parts of Kisumu, South Nyanza and Kisii Districts which are already registered indicate that for at least 80% any representative sample, the basis of access to land still remains inheritance and family partition and that this imposes a duty to administer the land with due deference to the actual or potential rights of other members of the family. (Okoth-Ogendo, 1978) . For example, in the older registration areas of South Nyanza and Kisii Districts it has been found that most people who did not succeed in having any land registered in their names and who, therefore, were technically landless, still believed that the fact of

registration alone could not destroy their interests in land which otherwise would belong to the lineage or the family as a single entity. Indeed this perception has some of whose members now argue that registration has merely created a trust relationship between the registered "proprietor" and his unregistered kinsmen. In areas currently undergoing reform, this anormaly seems to have corrected by simply anticipating inheritance claims and entering these in the register as accrued rights. The result is to undercut the original raison det're of registration, namely that it was intended to rationalise the vagualies of indigenous tenure and so facilitate free marketability of land in the rural areas. The effect of all these developments is that even when all land in the basin is registered, the theoretical foundation on which acquisition of land for development purposes is based namely, that the state has the power to extinguish access rights of individuals and to transfer them to its agencies, is not likely to be understood, leave alone entertained. Further the operation of land markets throughout the country indicates that the seeming rush in subdivision and transfer of land which normally accompanies registration tapers off considerably once a point has been reached at which further transactions begin to threaten the survival of the community. So avenues for the acquisition of land through consensus are likely to be closed as well.

iv). Settlement Patterns. This raises the important question of whether the LBDA will be able to re-organise settlement patterns within its development area without doing violence to society and thereby totally alienating itself from it. There is one major problem here and this relates to the experience of the local population with planned development. The harsh reality is that the Ahero Pilot project is regarded, at least in the flood plains, as the epitome of what is likely to happen when government through LBDA takes over the organisation of the local economy. This, in the minds of most peasants, implies some form of villagisation which in the case of Ahero, totally ignored the various taboos and other cultural mores which define residential patterns in Luo society. In the case of Ahero, however, this disruption was quickly absorbed by society through an intricate process of 'land begging' from the population outside the scheme area. Indeed in a large number of cases, residents of the scheme had enough relatives outside it to allow for this kind of adjustment to be made. Comprehensive development by the LBDA most certainly will preclude social adjustment along these lines. This is mainly because one expects a lot of land to be involved and therefore a much larger population to be resettled. This, coupled with the fact that the LBDA's development area is an extremely heavily populated area, might

turn out to be the major constraint to the institution's development efforts. This is the point at which self-planning by the residents of the area will have to be solicited. We expect, however, that in practice LBDA will try to satisfy its land needs in the tradition of existing development authorities, namely, by simply ignoring the land tenure issues and existing settlement patterns discussed above and proceeding via the Land Acquisition Act, 1968 to expropriate land resources on payment of compensation at government rates. If this happens, tremendous resettlement problems are likely to arise. In the past what happened is that people were simply given compensation and then bulldozed out of ancestral lands and left to find alternative sojourn on their own. Research done on acquisition of land into the Kerio Valley, Nzoia, Mumias and Awendo indicates that a large majority of the people are not in fact able to find land elsewhere. This is either because land is not available or because the compensation they receive is so low that they are not in a position to afford alternative land of comparable size and value. Others squander the compensation they are given thereby adding to the population of the rural landless and urban unemployed. The social consequences of this include not only the destruction of family institutions and ties, but also increased breakdown in law and order, psychological maladjustments and ultimately widespread rural poverty. The argument that these ills can be averted by absorbing these people into rural employment need not be evaluated since all past indications are that this is not a viable alternative.

SUMMARY AND CONCLUDING REMARK

The preceding sections have reviewed a number of societal and land use issues which are likely to arise once LBDA becomes operational. One general observation that needs to be made is that both the control structure and functions of and past experience with similar authorities, suggest that the very high expectations that people (particularly politicians) seem to have in the proposed LBDA may not in fact be justified. For formidable problems await that authority; problems generated inter alia by the resiliance of established land use systems, the goal orientation of existing development agencies, the politics of resource allocation in Western and Nyanza Provinces, the complexity of land tenure systems and the unavailability of land for resettlement within the area. These problems will have to be faced but who will do that is a different issue. For LBDA as presently proposed is in our view, ill-equipped to do so.

REFERENCES

ALDEV: 1946-1962. African Land Development in Kenya, Ministry of Agriculture Animal Husbandry and Water Resources, 1962.

OKOTH-OGENDO, 1978. The Political Economy of Land Law: An Essay in the Legal Organisation of Underdevelopment in Kenya 1897-1974. (JSD Thesis Yale Law School.).

RESOURCE BASE(S) FOR INTEGRATED INDUSTRIALIZATION AND DEVELOPMENT IN THE (KENYAN) LAKE VICTORIA BASIN

By

Prof. Reuben B. Ogendo,

Department of Geography
University of Nairobi.

1: INTRODUCTORY COMMENTS

a): A foreword

The declaration, by President D.T. arap Moi, on the 16th December, 1978, of the creation of the Lake Victoria Basin Development Authority established, for the first time in its history, a regional development organization for this area noted for its considerable economic potential.

It has already been observed that such a regional development authority would normally be expected to investigate into, plan for the development of and actually, fully develop in a comprehensive and integrated manner all the resources of the specified area, generally, on a long term basis. In this way, the Authority would transform the entire (Kenyan) Lake Victoria Basin Planning Region from the tract of country at present relatively depressed into one of the most prosperous localities in Kenya.

While the water-basin concept of promoting social and economic development is in no way a new notion in Kenya, it is nonetheless important, in the case of the Lake Victoria Basin Development Authority (dealing as it must with vast and dense populations in parts of the area), that we know exactly how to approach, execute and bring to the expected full fruition the social and economic development of the Basin. Indeed, if we are to learn and benefit from the past bitter experience emerging from similar but less well-managed water-basin projects both in Kenya and elsewhere in the world, the most effective and best rewarding development approach has to be applied. It has been suggested earlier that the best approach, in the Lake Victoria Basin case, would be to give full mandate and responsibility to the Lake Victoria Basin Development Authority to make decisions and executed them, and to ask and receive, promptly, in a co-ordinated fashion, the necessary assistance (and any other required expertise and/or advice) from the various Government Ministries as and when the Authority has need of such facilities.

In order that the Lake Victoria Basin Development Authority may realise the full results of their regional development plan, the latter must be seen to be both comprehensive and fully integrated. This would involve not merely setting its targets to include all the principal elements of the Lake Basin economy, but should, at the same time, be seen to embrace a complete spectrum of all the main development activities ranging from accelerated modern commercial and allied agricultural and industrial production, through the provision of reinforced and greatly diversified infrastructure and improved standard of living via better educational facilities, to complete employment and hence tangible incomes, better homes, health provisions and all the allied social services.

In short, Lake Victoria Basin, as one of Kenya's economic regions, would be made to have the capacity not merely to sustain but also to accelerate, in time, the pace of the entire spectrum of development improvements. If the Lake Victoria Basin Development Authority is to achieve its aims, it has to apply overall planning strategies so as to facilitate the use of the various limited resources of the area in the most productive fashion in every economic sector and subsector of the Basin.

b). Principal points this paper is expected to examine:

In order to keep the paper within a reasonable length and yet include all the points required, some shortcomings are to be expected in the paper itself. The points to be examined may be summarised as follows:

i) the resources of the Basin are to be discussed in an integrated manner especially those already introduced by the previous papers;

ii) the need to analyse the nature of the dynamic interaction among the above resources, especially, as the Lake Victoria Basin Development Authority plans and executes industrialization for the development of the economic region;

iii) the importance of showing the incidence and relationship of the resources in terms of:-
   1) spatial distribution, and
   2) abundance for economic exploitation;

iv) the identification as to which resources may have to be moved (if movable) to enhance development planning, and finally;

v) to recommend, in the final analysis, for purposes of future development planning:-

1) the various options a planner may have for the most efficient and effective use of the natural resources in the specified area, while indicating,
2) the existing or expected constraints against planned development in the area.

2: The geographically variable limits of the possible planning area of Lake Victoria Basin as contrasted to the politically fixed counterpart.

a): The politically determined planning area of the (Kenyan) Lake Victoria Basin:

When first announced, the Lake Victoria Basin Development Authority concept was supposed to be confined to Nyanza province. Later it was felt by some that the idea should be extended to include the Old Nyanza provincial boundary.

More recently, however, the area has extended to include the entire watershed or catchment area draining into the (Kenyan) Lake Victoria waterbody. As it is at present constituted, it is reasonably correct to estimate the size of the (Kenyan) Lake Victoria Basin as follows (Fig. 1):-

b): The geographically variable limits of the possible planning area of Lake Victoria Basin:

From Table 1, the Basin as consisting of the areas of Nyanza and Western provinces is merely about 24,522 Sq.km. including some 3,773 Sq.km. of water surfaces. However, viewed in the light of the approximate size of the entire (Kenyan) catchment area, which also includes part of the Rift Valley province, the geographically determined Lake Victoria Basin occupies about 51,482 Sq.km., including some 3,773 Sq.km. of water. On the other hand, if all the Kenya districts encompassed by or crossed by the catchment area boundary are to be considered as under the Lake Victoria Basin Development Authority, then the size of the entire area involved is about 71,920 sq.km., including some 3,949 sq.km. of water surfaces (Fig. 1; 1-4, q.v.). The author is of the opinion that this entire area is the ideal geographical realm of the proposed Lake Victoria Basin Development Authority, because the districts involved should be seen to be developed as a whole and not in part(s).

Table 1: Approximated and absolute area of the (Kenyan) Lake Victoria Basin (areas under water are indicated within brackets).

Districts and Provinces		Actual area in Sq. km.	Absolute area in Sq.km.
Siaya District		3528	(1005); 3528
Kisumu District		2660	(567); 2660
South Nyanza District		7778	(2064); 7778
Kisii District		2196	(-); 2196
Nyanza Province		16162	(3636); 16162
Busia District		1766	(137); 1766
Bungoma District		3074	(-); 3074
Kakamega District		3520	(-); 3520
Western Province		8360	(137); 8360
West Pokot District	approx.	1015	(-); 5076
Trans-Nzoia district	approx.	2468	(-); 2468
Elgeyo Marakwet District	approx.	1361	(-); 2722
Uasin Gishu District	approx.	3784	(-); 3784
Nandi District		2745	(-); 2745
Kericho District		4890	(-); 4890
Nakuru District	approx.	1440	(176); 7200
Narok District	approx.	9257	(-) 18513
Part of Rift V. Province		26960	(176); 47398
Estimated area of Lake V. Basin		51482	(3949); 71920

Source: Statistical Abstract, 1977.

3: Principal developable resources and development facilities in the Lake Victoria Basin.

a): Developable resources based on the physiographic endowment of the Lake Basin:-

i) Economic significance of topography (Figs. 2 & 3):-

1) its scenic beauty and touristic value,
2) its drainage and water supply controls (Figs. 3,9,10 & 19),
3) its influence on orographic rainfall from the Lake and temperature modifications,
4) its influence on vegetation, thus controlling both plant species patterns, abundance and their altitudinal zonation (Figs. 4 & 10).

5) its ecological zoning controls (Figs. 10, 4-6 & 11) determining certain human economic activities, such as agriculture (FIGS. 19-21), establishments of parks and game reserves (FIG. 6), tsetse and other animal controls (Fig. 11), and the need for soil and other conservation (Figs. 3,6 & 8),

6) its influence on general infrastructure (Figs. 16-18, 22-28).

ii) Importance of the rock contents (Figs. 7 & 8):-

1) presence of precious minerals, such as gold, silver etc.,
2) presence of other industrial minerals, such as copper, iron, radioactive minerals, limestone, road metal, etc.,
3) nature of soils as influenced by geology, topography, climate, vegetation and time, and its suitability for agricultural and allied purposes.

iii) Significance of climatic conditions (Fig. 9):-

1) influence of temperature on rainfall, etc.,
2) amounts, characteristics and reliability of the rainfall as affecting water-based economic activities - of: agriculture (Figs. 9 & 19),
3) water supply situation for domestic, industrial, commercial, irrigation and other purposes (Figs. 3 and 9),
4) influence of climate on rivers and their regimes and hydro-electricity potential of the rivers (Figs. 9, 3, 22, & 23),
5) adverse influence of climate such as the prevalence of animals which propagate diseases - of: mosquitoes and malaria, snails and schistosomiasis, tsetse fly and trypanosomiasis, etc. (Fig. 11).

iv) Economic value of vegetation and ecological zones (Figs. 4-6, 8-11):-

1) existing and modified vegetation cover, originally mainly combretaceous scattered-tree grasslands and isolated forests both at low and medium altitudes (of. the Kakamega, Mt. Elgon and limited forested areas in parts of South Nyanza, etc) and several varieties of other scattered tree grasslands (as in Narok), many varieties of high altitude forests (as in Kericho, Nakuru, Nandi, Uasin Gishu and Elgeyo Marakwet districts, etc.) and both forest remnants and forest-derived scattered - tree grasslands (as in the Mt. Elgon area). The

forests are valuable sources of timber, pulp and paper and firewood, while both the soils in the forests and areas occupied by the richer scattered-tree grasslands (see Fig. 19; 1 and 2.1) are good for agriculture from both the viewpoints of better rainfall reliability and plant nutrients (Figs. 8 and 9). Note the rangelands pattern (Fig.5). The Lake itself is a valuable source of fish and allied resources.

b): State of present development and development facilities in the Lake Victoria Basin:

i) Population issues affecting development in the Basin (Figs. 1, 8-18):-

The 1969 total population of the Basin proper was 4,682,000, while the 1969 total population of all the districts involved considered in full was 5,109,000. The population density per square kilometre varied from as low as 6.7 in Narok district to as high as 222.4 in Kakamega district and 307.4 in Kisii district. Both absolute population distribution (Fig. 12) and density (Fig.13) in the area are shown. Lake Victoria Basin is one of the most densely populated regions in Kenya. However, certain areas close to the Lake (such as Uyoma, Asembo, parts of Sakwa and Seme and sections of South Nyanza betray quite low densities, Fig. 13).

The structure of the population (as illustrated by the age-sex pyramids for Nyanza and Western provinces, Fig. 14) shows that the Basin exhibits the typical developing area population, with higher percentages of young persons within the (0-14) years age-bracket (50% in Nyanza, and 53% in Western). Those within the 65+ age-bracket vary from 8% in Western to 7% in Nyanza.

The independent population in the Basin proper during 1969 was 1,998,000 (or 42.7%) out of the total population of 4,682,000 (see Table 2). If all the districts involved are considered in full then the independent population in 1969 was 2,194,000 (or 42.9%) out of a total population of 5,109,000. In Nyanza province, the urban population in 1969 was 159,206, of which 58% (about 92,340 persons) was made up of independent bread-earners. In Western province, however, the urban population totalled 12,351, and consisted of 56% (about 7,000 persons) independent bread-earners (Fig. 15). The major towns in the Basin area are Kisumu (population 32,431 in 1969), Eldoret (population 18,196 in 1969), Kitale (population 11,573 in 1969) and Kericho (population 10,144 in 1969). All these towns have rapidly increased in population since 1969 and are at present greatly reinforced by smaller towns

Table 2: Total and independent population and population density of the Basin.

Districts, Provinces and dryland areas	Dryland Areas in Square Kilometres						
		Actual population			Entire district population		
Districts & Provinces	Dryland area	Independent population	Total	Density/ Sq.km.	Independent population	Total	Density/ Sq. km.
Siaya District	2523	165,000	383,000	151.8	165,000	383,000	151.8
Kisumu District	2093	172,000	401,000	191.6	172,000	401,000	191.6
South Nyanza District	5714	285,000	663,000	116.0	285,000	663,000	116.0
Kisii District	2196	290,000	675,000	307.4	290,000	675,000	307.4
Nyanza Province	12,526	913,000	2,122,000	169.4	913,000	2,122,000	169.4
Busia District	1629	78,000	200,000	122.8	78,000	200,000	122.8
Bungoma District	3074	135,000	345,000	112.2	135,000	345,000	112.2
Kakamega District	3520	305,000	783,000	222.4	305,000	783,000	222.4
Western Province	8223	518,000	1,328,000	161.5	518,000	1,328,000	161.5
West Pokot District	1015	7,000	16,000	16.1	38,000	82,000	16.1
Trans Nzoia District	2468	57,000	124,000	50.2	57,000	124,000	50.2
Elgeyo Marakwet District	1361	37,000	80,000	58.4	73,000	159,000	58.4
Uasin Gishu District	3784	88,000	191,000	50.5	87,000	190,000	50.5
Nandi District	2745	96,000	209,000	76.1	96,000	209,000	76.1
Kericho District	4890	220,000	479,000	97.9	220,000	479,000	97.9
Nakuru District	1440	27,000	58,000	41.4	134,000	291,000	41.4
Narok District	9257	30,000	65,000	6.7	58,000	125,000	6.7
Part of Rift V Province	26,960	567,000	1,232,000	45.7	763,000	1,659,000	35.1
Estimated total (area & population of Basin	47,709	1,998,000	4,682,000	98.1	2,194,000	5,109,000	75.2

Source: Derived from the Kenya population census, 1969.

such as Kakamega, Webuye, Homa Bay, Kisii, Kapsabet, Siaya, Maseno and Bungoma (Fig. 16).

In isolating independent population from the dependent population within the Basin, our aim is to treat the independent population as an essential part of infrastructure required for developemt in the planning area. The larger proportion of this independent population (over 80%) is either unskilled or semi-skilled labour. The remaining 20% (actually an over estimate) consists of low, middle and high level manpower, much of it in the urban areas of the region.

In order to improve "the human skills" in the area, other infrastructural facilities providing a variety of training media have been and are being established in the Basin (Fig. 18). These vary from primary schools, village polytechnics, vocational secondary and other schools, technical and other colleges and many similar facilities. Moreover, to maintain the population in a healthy state, many medical facilities have also been established in the area as part of the essential infrastructure (Fig. 17). Thus, many of the health hazards, such as trypanosomiasis, schistosomiasis, cholera, malaria, leprosy and many other diseases, are being subdued, including those which affect the domestic livestock.

In view of excessive population densities in certain parts of the Lake Basin (see Figs. 12 and 13), efforts should be made by the Lake Victoria Basin Development Authority to lessen the higher densities, especially in Kisii and Kakamega districts, by re-populating the less dense areas with good (especially, agricultural) development prospects (Figs. 8-11, 13 & 19). This strategy, which is mainly based on improved agricultural production (especially in terms of raw materials for industrialization) should be carefully coordinated with rainfall reliability (Fig. 9), soil fertility (Fig.8), the best range lands for livestock (Fig.5), forest exploitation (Fig.4), utilization and conservation of wildlife (Fig.6), exploration and exploitation of economically feasible mineral resources (Fig. 7) and proper coordination and use of the ecological zones in relation to agriculturally productive land (Fig. 10 and 19).

ii) Agricultural crops and livestock:

1): Subsistence -cum-local commercial agricultural production:-

A number of crops are produced mainly for local consumption. Good examples are a series of millets, sorghums, some cassava, simsim, pulses, etc. These are purely subsistence and, except for cassava which has potential industrial significance, such subsistence crops may be improved and used better in the future, may be even as raw material sources for industry.

However, products such as wheat, sugarcane, commercial forests, a variety of maize, bananas, groundnuts, livestock, especially, cattle and rice many be regarded properly as subsistence-cum-local commercial in nature. Indeed, some of the manufactured products from the above already find their way out of Kenya as exports, for example, butter, tinned beef, etc.

The Lake Basin is already noted for several of these subsistence-cum-local commercial products, especially maize, rice, bananas, groundnuts, forests, cattle and especially sugar-cane (Fig. 20).

Considerable room for improvement still remains to be realised in the future. Much progress has been made in the development of sugarcane, although the crushing capacity and ancillary industries based on cane by-products, such as molasses, bagasse, filter-cake, etc., have yet to be established and/or improved. In all cases, attempt should be made to make such industries fully integrated, so that the industrial activities in urban areas are seen to be planned side-by-side and in close coordination with the economic activities in the rural areas, in order to curb rural-urban migration.

ii) 2): Commercial agricultural production:-

The most important commercial crops cultivated within the Lake Basin include coffee, tobacco, tea, cotton, pyrethrum and wattle. Except cotton which is cultivated nearer the Lake itself, many of the commercial crops are grown in the higher and cooler areas to the north and south of Winam basin proper (Figs. 1,2 and 21). Practically all the commercial crops can form the raw material bases for development inducing manufacturing industries. The best examples are the outgrower tea, coffee pyrethrum and tobacco and cotton for the textile industry.

It is not the intention of the author to introduce production data relating to the above subsistence-cum-local commercial and commercial crop and animal products (as those belong to the previous individual papers already presented and fully discussed), but rather to indicate their spatial patterns within the Lake Victoria Basin in relation to the agriculturally productive land (Fig. 19, 1-2.1), as opposed to agriculturally marginal land (Fig 19, 2.2) and the various livestock rangelands (Fig. 19, 3.1 and 3.2). These organic resources, which should include the Lake fisheries resources, (Fig. 4-6, 10, 19-21) and the allied inorganic resources (Figs. 2,3,7-9) and development facilities (Figs. 12-18) are displayed here in order to lay proper foundation for discussions relating to factors influencing industrial location.

iii) Standard infrastructure:

1): Road and railway network regions and accessibility within Lake Victoria Basin:-

These are already quite well established and are increasingly being reinforced (Figs. 26 and 27). Much of the Basin is easily accessible (Fig. 27), except in the highest areas such as Mt. Elgon and the Mau Hills.

Even the telephone network is being extended in the area and the Kisumu communications focus has been greatly expanded. Moreover, the Kisumu airport has been expanded so as to handle larger aircraft.

2). Hydro-electricity potential of the Basin rivers and present pattern of electricity distribution within the planning area:-

The chief rivers of the Basin are Nzoia, Yala and Kuja, viewed from the light of hydro-power harnessing (Fig. 22). Webuye and Yala falls have yet to be assessed for hydro-electricity development. The only established hydro-power stations within the Basin are those at Gogo Falls on river Kuja and at Sosiani (near Eldoret) on Nzoia tributary of Sosiani (Fig. 23). However, the Basin has several standby power stations (Fig. 24), and receives electricity mainly from the Owen Dam in Jinja Uganda (Fig. 25).

4: Industrialization in Lake Victoria Basin.

(a) Historical Background to Industrialization in the Lake Basin:

The establishment of industry in Kenya started in a small way in the main urban areas of Mombasa and Nairobi, the earliest urban centres of any importance at that time. However, as European and other foreign settlers (including some Asians) occupied land suitable for agriculture in various parts of Kenya, especially in the Highlands and at the Coast, a wide variety of industrial raw materials based on agricultural production became locally available. During the early years however, most of these commodities were exported abroad largely in their raw forms for processing overseas. In a few cases, such as sisal decortication, cotton ginning, etc., simple processing plants, which were later improved and made more sophisticated, were introduced and their number increased in the course of time.

It will therefore be observed that the initial manufacturing industries were either located in the urban areas or within the urban and/or rural areas alienated to the European and other associated settlers.

While these alienated areas and their associated urban centres were mostly prevalent in what used to be known in Kenya as the "White Highlands", parts of these areas projected peripherally in the Lake Basin in districts such as Kericho, Nakuru, Nandi, Uasin Gishu, Kisumu and Trans Nzoia.

Thus, certain of these peripheral Lake Basin districts became tea, coffee, pyrethrum, wattle, sugarcane, dairy and beef areas or some rootable significance. Within such areas were established factories processing tea (as in Kericho and Nandi), coffee, prethrum (as in Nakuru), wattle (as in Eldoret), sugar (as at Miwani, formerly called "Bungu"), etc.

As agriculture improved, the non-alienated African areas also became important for crops such as cotton and maize and finally coffee, tea, pyrethrum and many of the more profitable commercial crops, especially as independence was approached and the war of agricultural politics waged against the Africans regarding the cultivation of certain commercial crops (such as coffee, tea, etc.) waned.

Apart from the main urban centre of Kisumu, where manufacturing and service industries developed, albeit rather slowly, most of the non-alienated areas occupied of the Africans in the Lake Basin proper has very few or no manufacturing industries of any importance. This accounts for the relatively poorer industrial content of the two Lake Basin provinces of Nyanza and Western, as compared to the peripheral districts of the Rift Valley within the so-called "White Highlands", where the settler capital and know-how and the colonial Government's interest backed by financial and other assistance, served as favourable industrial location factors (Tables 7-9).

It is during the last fifteen years of independence that the "Wanachi" Government has had, as one of its development aims, to decentralize the industries, thus encouraging the establishment of more of the agricultural based industries in the formerly neglected Lake Basin districts, such as South Nyanza, Kisii, Kakamega, Bungoma, Siaya, other parts of Kisumu districts, etc. The industrial development effort is, however, yet a matter of a drop in the ocean, as the listed tables above show.

b): Existing structure of manufacturing and services industries:-

On the basis of either imported or local industrial raw materials within the Basin, the structure of industries established here may be summarised under the following two composite headings, namely:-

i) the agricultural manufacturing industries, and
ii) the non-agricultural manufacturing and service industries.

These may, in turn, be split into smaller composite (and/or individual) groups of industries as presented in Tables 3 - 6.

The 23 individual agricultural manufacturing industries consist of eleven agricultural processing industries (Table 3) and twelve agricultural non-food manufacturing industries (Table 4). Morecver, the 16 non-agricultural manufacturing and service industries fall into the two sub-groups, namely, eight non-agricultural manufacturing industries (Table 5) and a further 8 service industries (Table 6).

It will be observed that the service industries included among the 16 non-agricultural manufacturing and service industries are much more closely associated with manufacturing than the other service industries, such as insurance. banking, commerce, etc.

Each of the Tables (3-6) is structured so that the location of the individual industries or a composite group of industries (especially on the basis of the operatives as an index of measurement of localization) may be perceived either as rural, urban or both.

Engaged in the 454 factories (each employing 5 or more operatives) in the agricultural food processing industries in the Lake Basin (mostly in the rural areas), representing about 33.9% of all the factories located in the Lake Basin districts (about 10% of Kenya's total), there are some 16,302 operatives, approximately 29.3% of Lake Basin districts total in all the manufacturing and service industries (and about 8.4% of Kenya's total).

Similarly occupied in the 414 factories (each employing 5 or more operatives) in the agricultural non-food manufacturing industries in the Lake Basin (mostly in the urban areas although, operative-wise, nearly fifty-fifty with about 1,000 more operatives in the rural areas than in the urban centres), which account for about 30.9% of all the factories located in the Lake Basin districts (about 9.2% of Kenya's total), there are some 25,661 operatives, about 46.2% of the Lake Basin districts total in all manufacturing and service industries (or 13.2% of Kenya's total).

From the above structural analysis of factories and operatives in the two composite groups of the agricultural manufacturing industries in the Lake Basin districts, it is obvious that these are, by far, the most important of all the manufacturing and service industries located within the Lake Basin on the basis of the operatives.

Thus, engaged in the 868 factories (each employing 5 or more operatives) in the entire agricultural raw-material based processing and fabrication industries located within the Lake Basin districts (most of the factories and their operatives being located in the rural areas), which account for about 64.78% of all the factories located in the Lake Basin districts (that is, about 19.2% of Kenya's total), there are 41,963 operatives, approximately 75.5% of the Lake Basin districts total in all the manufacturing and service industries (or about 21.5% of Kenya's total).

The non-agricultural manufacturing and service industries, accounting for 567 factories (each employing 5 or more operatives), in the Lake Basin districts (mostly located in the urban areas) and representing about 42.3% of all the factories located in the Lake Basin districts (or about 12.5% of Kenya's total), at present employ about 13,597 operatives, approximately 24.5% of Lake Basin districts total in all manufacturing and service industries (or about 7.0% of Kenya's total). Tables 5 and 6 provide further details comparable with what was given above for the agriculture food and non-food composite industrial groups, which see.

It is important to observe, therefore that, in terms of industrial employment, the order of significance of the two larger composite industrial groups, is, first, the agricultural manufacturing industries and, second, the non-agricultural manufacturing and service industries. This is not true merely within the Lake Basin districts, it is true in Kenya as a whole.

The other point of significance in these structural analyses of industrial employment in the Lake Basin districts in the distribution of such operatives amongst the various factory size-groups (Table 9). The table provides the employment structure by districts and points, not only to the preponderance of factories in the (5-19) and (20-49) operatives size-groups, but also to the employment significance of the fewer but larger factories varying from those each employing 200 or more operatives. Thus, in the Lake Basin districts, out of the 55,560 operatives in the 1340 factories (each with 5 or more operatives), 30.3% of them were employed in the 42 larger factories (or 3.1% of the Lake Basin districts factories) each with 200 or more operatives. The most numerous factories numbering 1077 (or 81.4%) in the two size-groups of (5-19) and 20-49) operatives, only account for 31.9% of the 55,560 operatives total in the Lake Basin.

B): Location of the manufacturing and the allied service industries:-

On a qualitative basis, the pattern of factory sites, minor industrial centres and the main urban centres housing many of the small and/or principal industries may be seen in the accompanying sketch map (Fig. 29). The quantitative pattern (Fig. 31), however, may not reveal some of these clusters of small-size factories, some of which employ fewer than 5 operatives each. The Lake Basin districts show considerable density of factories in Kisumu town and to the east of that town. Significant factory site-clusters are also noticeable in Kisii district and in parts of South Nyanza and Kakamega districts. Siaya and Bungoma districts have much lower factory sites, while Busia district hardly has any industries worth discussing (Fig. 30).

These location details are, to some extent, emphasized by Tables 7.1-7.4 and 8.1-8.4, which provide district factory and industrial operatives data both for the political Lake Basin districts and the geographical Lake Basin districts. In the former area, Kisumu district leads in industrial employment.

It will be observed that Nyanza and Western provinces (or the Political Lake Basin area) account for about a third of industrial employment in the geographical Lake Basin area. Thus, most of the Lake Basin industries are located in the peripheral districts of Nakuru, Uasin Gishu, Kericho, Trans Nzoia and Nandi. However, the Political Lake Basin area has considerable industrial potential in the light of existing undeveloped resources (both organic and inorganic, see earlier papers on these, listed in the accompanying bibliography).

Table 7.1-7.4 and 8.1-8.4 show the location of the manufacturing and the allied service industries not only by districts and provinces, but also in terms of the larger urban centres and the general share of the rural areas. Moreover, each of the individual industries are isolated and presented by districts. Thus, the employment role of each industry, its size and its variation from one Lake Basin district to another and also its significance in Kenya as a whole could be observed from the above 8 tables. Thus, in terms of factories (each with 5 or more operatives) the Lake Basin districts together account for 29.7% of Kenya's total, while the same districts employ 28.5% of Kenya's total operatives in all the manufacturing and service industries. In Kenya, some of the industries (such as sugar, tea, sawmilling, etc.) are mainly located in the

Lake Basin districts. The largest industry in the Lake Basin is fibre processing followed by sawmilling. These two together account for nearly 28% of the Lake Basin industrial operatives (or nearly 8% of Kenya's total).

c): Principal factors influencing location of industries in the Lake Basin districts:-

Because most of the industries are based on agricultural raw materials, they are considerably influenced partly by those environmental factors which control the agricultural activities and, consequently, affect agricultural production. Many of these factors are essentially ecological, especially rainfall (amount, incidence and reliability). Agricultural crops and livestock are at their best in certain ecological and agricultural land productivity zones, involving a wide variety of soils (Figs. 8-10 and 19). Moreover, those areas free from disease propagating animals (such as tsetse flies, etc.) and with good and easily available water supplies for industry are more favourable.

The non-agricultural manufacturing industries which are raw-material orientated, such as the Koru Homa Lime industry, are also controlled by the environment, in terms of the spatial pattern of mineral concentrations (Fig.7).

The above factors of location are, in no way, the only ones controlling industrial location in the Lake Basin districts. Even more far reaching are the economic and social factors. The availability of capital and managerial skills, the role of infrastructural facilities (such as roads, railways, other lines of communication, education, medical and the allied services, etc) and influence of politics and government policy are very important factors influencing industrial location in the Lake Basin districts. A number of irrigable areas with suitable soils have been irrigated, thus attracting new industries, as in Kano, Yimbo and Bunyala. Several areas in the Lake Basin have recently been brought within electricity distribution spheres in the process of rural electrification. Still more important, as a "pull" factor, are the main urban centres in the Lake Basin (Figs. 16 and 29), within which many important industries are located (Tables 3-6 and 7.1-7.4 and 8.1-8.4).

Influence of politics has played a relatively negative role in the past, especially, in the Lake Basin core districts of Nyanza province and, to a less extent, in Western province. However, since the Lake Basin Development Authority itself is, indeed, a direct political development, as a result of the President's directive, the influence of politics, especially as concerns the future of the Basin, may prove a very crucial industrial location factor in the entire Lake Basin area.

5: Industrial re-allocation to redress economic development imbalances in the Lake Basin.

a): Nature of the re-allocation of industries:

The existing spatial pattern of industrial development in the Lake Basin betrays many imbalanced characteristics, especially when viewed in the light of existing and potential development facilities in the area under study (Fig. 1). Ecologically, a much wider range of crops and livestock than exist in the area at present could be established (Figs. 10, 19-21). Moreover, much of the Lake Basin (especially the areas underlain by the older rocks) houses a wide variety of minerals, some of which exist in economic quantities yet to be ascertained, while others are yet to be prospected (Fig. 7).

The establishment of electricity in parts of the Lake Basin (Fig. 25) and the expansion of the other infrastructural components, such as roads, other lines of communication, better education and medical facilities, more urban centres, etc., auger well for more favourable conditions on which to base a more balanced re-allocation of industries in the Lake Basin.

b): Need for population shifts within the rural areas of the Lake Basin:

Such rational re-allocation of industries calls for a re-patterning of population with a view to de-congesting the areas, at present, experiencing rather higher densities, such as parts of Kakamega district and the whole of Kisii district. Although most of the core Lake Basin districts in Nyanza and Western provinces are relatively densely populated (Figs. 12 and 13), readjustments for further settlement are possible in South Nyanza, Siaya, Busia and Bungoma districts. However, the best openings for surplus population from the core districts of Kisii and Kakamega are, perhaps, the peripheral districts of the Lake Basin, especially Kericho, Trans Nzoia, Uasin Gishu, parts of Nandi and Narok. In so shifting the surplus population to the less densely populated districts (Fig. 12), urban and rural development planning should be closely coordinated on the basis of development inducing industries, especially those that specifically tie the urban centres with their tributary rural areas from which they have to rely for their raw materials, with the resulting monetary plough-backs into the rural economy (of: textile industry based on cotton growing or coffee milling based on coffee cultivation in the rural sector). Such an approach should mitigate against rural depopulation, especially if diversified with other economic incentives to be located in the rural areas, such as the active development of service centres and other similar infrastructural attractions established in such rural areas. The population

shifts should be related closely, especially, with the establishment of educational and medical facilities (Fig. 32).

6: Suggested integrated economic development planning in the geographical Lake Basin region.

a): The role of the planning map (Fig. 33):-

Given a) the natural resources (such as, say, 1) the most favourable ecological zones (Fig. 10); 2) large areas with land of high potential agricultural productivity (Table 1, and Fig. 19), supported by both: 3) rainfall of high reliability (Fig. 9) and, 3) relatively fertile soils (Fig. 8); 4) excellent prospects of a wide variety of industrially valuable minerals (Fig. 7); 5) very good prospects of establishing relatively cheap and reliable water supply network for all type of economic activities, and; 6) great tourist industry potential); b) the already developed infrastructure (Figs. 17, 18, 23-26,29), including the planned expansion of these, and; c) the vast human resources for development within an area noted for its labour supply potential (Table 2 and Figs. 12, 14 and 15), what is needed most are, inter alia, capital, proper management and technical know-how.

Over fifteen variables (some negative relative to development) are presented side by side in the accompanying planning map (Fig. 33). Excluding the negative variables (such as presence of tsetse flies, area located inside poor water supply belts, etc.), it will be observed that the concentration of the positive variables indicate fairly extensive areas with high potential for development in the Lake Basin districts.

It is clear from the planning map that the core Lake Basin districts are, to a large extent, very well favoured, while some of the peripheral districts, (such as Narok, parts of Nakuru, etc.) are far less favourable for intensive development.

On the basis of this map (Fig. 33) and that of population density and the absolute population dot map (Figs. 12 and 13) it is possible to see where to move extra population as development proceeds as planned by the Lake Basin Development Authority. Note that the towns are categorised for development, either as development centres (the most important towns with key development inducing industries) or as development points. More of the latter should be established along with many new service centres in the Lake Basin in future.

Taking the geographical Lake Basin districts together (and may be with emphasis, during the early stages, on Nyanza and Western provinces, which constitute the Political Lake Basin), it is important to develop practically all the available resources, from those which are natural and untouched to those already "more" or "less" developed or introduced by man. It is also vital that strict measures for utilization and conservation should be adhered to in order to preserve (where renewable) and conserve as much as possible (where non-renewable) the resources.

b): Development-orientated classification of industries in the Lake Basin districts:-

Planning should be such that the urban and the rural areas are developed in a coordinated fashion. For instance, certain industries located in the urban areas (such as the last and most important stages of coffee processing) depend heavily on the raw materials from the rural areas. The result, in the case of coffee, is that much money from the urban centres (engaged in these last stages of coffee processing) is ploughed back into the rural sector (where the earlier stages of coffee processing and which also include the actual cultivation of coffee) for the benefit of the farmers and others in the rural areas. Thus, the coffee industry (viewed in the above light of monetary and industrial inter-relationship between rural and urban counterparts) is a good example of (mutual) development inducing industry. It is unlike certain other urban located industries, which tend to draw money from the rural areas, while allowing no plough backs hence perpetuating parasitic tendencies on rural areas.

Thus, we should encourage those truly "development inducing industries" some (such as coffee industry) which could actually be located in the urban areas, as well as those (such as sugar processing, complete with maximum numbers of individual (rural) outgrowers) which are normally located in the rural areas.

In the process of achieving the above aim, we should also bear in mind that there are industries which generate high profits (or high operating surpluses) and which are beneficial, first, directly to the entrepreneurs and, secondly, indirectly to the local population, because there is the possibility (and only on the basis of such possibility) that such profits could be used to establish new (especially development inducing) industries either in the urban or rural areas concerned. Such new industries (especially if they are development inducing) are likely not merely to provide additional employment opportunities in the area they are established, but may (if properly planned and controlled by Government policy, especially in the rural areas) possibly derive

their raw materials from the surrounding areas thereby sustaining rural development.

Generally speaking, practically all industries located in the urban areas, in one way or another, induce some development there. However, not all the industries located in urban areas induce development in the surrounding rural areas. Some of the urban located industries not only draw money from the rural areas making them poorer, but they also cause depopulation in the surrounding rural areas through migration to the towns.

Moreover, even those industries such as tea, sugar and pineapple processing, for example, could only be development inducing in the rural areas provided individual outgrowers (rather than plantation companies oblivious of rural development for the rural people) are involved first and foremost and, perhaps, reinforced by nucleus plantation units.

Development inducing industries, especially those in the rural areas, should be reinforced by supporting industries (such as the services, for example, means of transport). We may, thus, broadly classify the industries located in the Lake Basin districts, in terms of inducement of rural development as follows:

a) High potential development inducing industries:-
   i). Agricultural manufacturing: 2; 8; 9 and 10;
   ii). Non-agricultural manufacturing: 24-27; 30; 34: 38 and 39, and;
   iii). Services (supporting): 33 and 35.

b) Moderate potential development inducing industries:-
   i) Agricultural manufacturing: 1;3;4;12;14; 17 and 23;
   ii) Services (supporting): 28; 29; 31; 32 and 36.

c) Low potential development inducing industries:-
   i) Agricultural manufacturing: 5;6;11;13;15;16;18-22;
   ii) Services (supporting): 37.

So long as urban and rural planning is rationally coordinated, with the ultimate aim of ploughing back money and know-how into both rural and urban development as equal and mutual counterparts, the possibility of a properly balanced development in the Lake Basin districts is almost a certainty. However, planning for the urban centres at the expense of the rural areas is bound to end in much worse polarisation. The only solution in planning for the urban and rural areas is to look upon urban areas as development centres and points in which are established development inducing industries relative especially to the rural areas.

c: Development points, centres, areas, zones and axes in the Lake Basin:-

Certain small urban centres or single industrial centres (such as Kisii, in the case of small urban centres, or the Mumias Sugar Complex, in the case of industrial centres) are established and exist by virtue of one or two large or several small development inducing industries. It is such centres that are referred to in this paper (and in Figure 33) as development points. In certain cases (such as the Sudi located Nzoia Sugar Factory in Bungoma district, the Awendo Sugar Complex in South Nyanza and several others) the current industrial status of the centre is potential but imminent or else not significant in terms of our standard definition of "development inducing" industry. A number of such points are shown in Figure 33.

Development points are considered as such in relation to economic development (that is both innovative change to better and more sophisticated products and higher output of the same). While some potential development points also serve as service centres, it is not automatic that each and every potential development point is also a service centre. However, sooner or later potential development points and, especially, development points (proper) become associated in one way or another with a service or several services. Indeed, most development points are also service centres of varying categories.

While most potential development points and, practically, all the (non-industrial or purely) service centres are, as a rule, small in terms of population, development points vary in population from mere rural centres or factory sites to small towns (such as Webuye). Indeed, some of the development points have substarial populations.

Several of the initial development points have grown into large towns, for example Kisumu. The latter is, today, more than a development point; indeed, Kisumu is one of the three development centres in the Lake Basin, along with Nakuru and Eldoret. Figure 33 enumerates the development points located in the Lake Basin both in order of population and in terms of industrial grading (in the light of number and operative sizes of the factories housing development inducing industries located in such development points). All development centres are also the principal service centres of the Lake Basin.

On the basis of a series of variables (here referred to as development facilities, some of them, in fact, development constraints, for example, tsetse fly infested areas, etc), the Lake Basin naturally falls into certain distinct "development areas". Before examining these, it is usefull to observe that

development facilities and constraints fall into two principal groups, namely, natural and man-introduced or man-influenced. The first group includes such "natural resource" development facilities as: a) land productivity potential (comprising the patterns of 762 millimetre (30-inch) rainfall reliability, soil fertility grades, vegetation belts and the associated land potential plant indicators); b) prospects of establishing water supplies for domestic, industrial, commercial and other public needs (often a constraint in places); c) the existence of a variety of rangelands for domestic livestock and wildlife purposes and, hence, facilities for the development of dairy, beef and tourist industries based, among other things, on national parks, game reserves, controlled and conservation areas, sanctuaries (including marine equivalents) and the principal pasture lands. d) The minerals and mineralized areas and the associated facilities for mineral-based industries. e) There are also the constraints associated with disease carrying animals and plants, such as tsetse flies, mosquitoes, ticks, snails, fungi, etc. These natural resource-based development facilities and constraints are shown in the planning map (Fig. 33).

Along with them are the man-introduced or man-influenced development facilities, which include a wide variety of infrastructure (including not only roads and railways and their regional network densities (Figs. 26-27 and 33), but also agricultural complexes, consisting of well developed areas of the principal commercial crops (such as coffee, tea, sisal, wattle, cotton, tobacco and pyrethrum), the main subsistence-cum-local commercial crops and livestock (such as wheat, sugarcane, forests (indigenous and exotic), maize, bananas, groundnuts, rice and cattle (both beef and dairly), sheep (for mutton and wool) and goats). Some of the agricultural complexes are based on irrigation (such as in Kano around Ahero and Kabonyo Nauru, Kadenge/Imbo and Bunyala for either rice or sugarcane or both). Human-introduced constraints include, inter alia, soil erosion, pollution of water and air, etc.

Apart from human infrastructure based on independent population (Table 2), the latter functions best if well served by educational and medical facilities (Fig. 33), both the latter varying directly as the density of population in certain parts of the Lake Basin (Figs. 13, 17 and 18). Another important infrastructural facility is the pattern of electricity distribution areas (Figs. 22-25 and 33).

On the basis of the above patterns of production and infrastructural facilities, the existing urban centres (three of which are listed as development centres and about 20 as a variety of development points) are patterned in response to some of the above development facilities, especially, the infrastructural facilities and according to the spatial pattern of agricultural

and other productive activities. A detailed classification of such urban and other centres in terms of both population and industrial or purely service status is given in the accompanying maps (Figs. 16 and 33). It is of interest to study and consider these urban areas (population-structure wise) and the rural areas (Figs. 14-16) as mutual complements in any development planning.

About the three development centres of the Lake Basin, (namely, around Nakuru, Kisumu and Eldoret and, to some extent around the larger development points, such as Kitale, Webuye, Kericho and Kakamega), are areas which tend to develop relatively faster, especially in response to either the needs of the relevant development centres and points, or due to the boundary extension of the development centres and points (for instance: recent urban boundary extension in, virtually, all cases of the existing townships).

However, apart from the development areas associated with the development centres and points in the Lake Basin (Figs. 26 and 29), there are those forming islands, (such as the principal coffee and tea development areas of the Lake Basin, the sugar belts in Kisumu, South Nyanza, Kakamega and Bungoma districts, the irrigated rice areas in Ahero and Bunyala and the great possibilities in the tourist industry (around the Lake, the Nandi-Nyando Escarpment, the Lake Basin Rift Valley West of Kericho, etc., Figure 6). Great possibilities of creating new development areas exist in the Lake Basin, depending on the planning strategies of the Lake Victoria Basin Development Authority. However, the existing development areas form zones north, south and east of Winam (the Victoria Gulf). These zones, to a large extent, are orientated in axes according to the alignment of roads and rail networks in the Lake Basin (Figs. 12,16,17,18, 25,26 and 29) in response to certain economic activities, as are portrayed by the maps just enumerated above, which see.

However, granted the existence and possible further planned establishment of the development points, centres, areas, zones and axes within the Lake Basin, we cannot fail to recognize the over all geographical zoning of the "extended" economic Lake Basin region into the following (Figs. 1 and 33):-

1): the core planning area of Nyanza province;

2): the core "fringe-zone" of Western province;

3): the inner fringe zone forming the Western-most parts of the Rift Valley Province, but within the Lake Basin catchment area, and;

4): the outer fringe zone outside the Lake Basin Catchment area, but forming parts of some of the districts partly within the Lake Basin proper. The development of these affected districts should be seen as a whole and not in part, hence the significance to the Lake Victoria Basin Development Authority of the "Outer Fringe Zone".

If the Lake Victoria Basin Development Authority is to succeed in realizing integrated development of the region in question, consideration will be given to several problem areas, such as those constantly flooded by rivers (for example, the Nyando and others) which often overflow their banks and flood the Kano plains, etc. Moreover, several areas (some of them, paradoxically adjacent to this august fresh water Lake) are virtually semi-arid and not fully available for agriculture at present (Fig. 9: see parts of South Nyanza, Uyoma, Asembo, Seme, etc.). These will have to be irrigated in the future and more people from the densely populated areas of the Lake Basin settled there.

On the basis of soil fertility (Fig. 8), 762 millimetre (30-inch) rainfall reliability (Fig.9), ecological zones (Fig. 10) and agricultural land productivity potential (Fig. 19), within the Lake Basin, further shifts of population from densely peopled areas, such as Kisii and Kakamega districts, to less densely populated high and moderate potential agricultural areas (Figs. 12 and 19), such as Busia district (provided the flood, malaria and schistosomiasis hazards are also alleviated), Bungoma district, Trans-Nzoia, Nandi and Kericho districts. Those who are orientated towards beef cattle ranching may be resettled in the Narok district, since the land potential in this district is partly marginal, especially to the east (Fig. 19).

Although the Lake Basin districts are fortunate in that they are mostly free from the tsetse fly menance, parts of districts such as Narok, South Nyanza and parts of Asembo, Sakwa and Alego in Siaya district still betray remanants of the fly menace. These remnants therefore constitute problem areas characterised by this fly constraint to development. There is need for the elimination of this constraint through regular spraying with suitable insecticides, organized constant bush clearance and establishment of permanent normal agricultural practices.

Some of the areas are too stony or gravely and may be too rugged for settlement, as is the case of much of the Nandi-Nyando Escarpment. However, the area could be planted with exotic commercial trees and forests created. Moreover, this area appears to be one of the most promising tourist attraction in the Basin. The Maragoli and Bunyore areas farther to the north are other examples where the natural environment could be greatly improved by conservation through afforestation of the most rocky areas, as the dense population is shifted to better parts with higher agricultural potential.

Backed by such integrated development planning aimed at using all the enumerated development facilities (where the urban and rural economic development sectors are organized such as to complement each other), the possibility of adverse polarisation will be arrested. On the basis of carefully located and well structured service centres, development points (most of which are provided with, at least, the most essential services) and development centres, the properly planned development area patterned along suitable development axes could advantageously be fitted within the various geographical core of fringe zones by the Authority as broadly suggested by the patterns of existing and potential development facilities (Fig. 33)

d): Future Outlook:-

However, much work still remains to be done in order to gain better knowledge of the true potential of such resources as minerals, water-power, water as a resource, soils, feasibility of new commercial crops, better industrial exploitation of the existing commercial crops and livestock, including the development of ancillary industries based on the various by-products of the existing and future main manufacturing industries in the Lake Basin districts.

The research openings and consequent possible economic development based on the absolute economic potential of the Lake Victoria Basin no doubt point to a most promising future, not merely for the people who live or may, in the future, decide to go and live there, but for Kenya as a whole. In a sense, the Lake Basin districts could become one of those very valuable Kenyan sources of economic strength necessary for proper take-off in its industrialization and the consequent development into an advanced economy, thus taking its rightful place amongst similar developed economies of the world.

BIBLIOGRAPHY

Bale, J. 1975 - The location of manufacturing industry: conceptual frameworks in geography - Oliver and Boyd.

Boudeville, J.R. 1966 - Problems of regional economic planning- University Press, Edinburgh.

Bryce, M.D. 1960 - Industrial development - McGraw-Hill.

Bryce, M.D. 1965 - Policies and methods of industrial development - McGraw-Hill.

Butler, F. 1975 - Growth pole theory and economic development- D.C. Health Ltd. (Hants, U.K.).

Conroy, M.F. 1973 - Rejection of growth centre strategy in Latin American regional development planning - Land Economics, Vol. 49, No. 4, pp. 371-80.

Darkoh, M.B.K. 1977 - Growth poles and growth centres with special reference to developing countries: a critique - The Journal of Tropical Geography, Vol. 44, June.

Darwent, D.F. 1969 - Growth poles and growth centres in regional planning: a review - Environment and Planning, Vol.1, No.2, pp. 5-32.

Friedmann, J. 1972 - A general theory of polarised development, in N.M. Hansen (ed.) - Growth centres in regional economic development - The Free Press, N.Y., pp. 82-107.

Friedmann, J. 1973 - Urbanization, planning and national development - Sage Publications (Beverly Hills).

Gilbert, A. (Edit.) 1976 - Development planning and spatial structure - Wiley.

Government of Kenya 1970 - Nyanza and Western provinces - regional physical development plans - Department of Physical Planning, Ministry of Lands and Settlement, Nairobi.

Government of Kenya 1977 - Statistical abstract - Central Bureau of Statistics, Ministry of Finance, Government Printer, Nairobi.

Government of Kenya 1979 - Development plan 1979-1983 - Ministry of Planning, Government Printer, Nairobi.

Hall, P. 1975 - Urban and regional planning - Penguin books.

Hansen, N.M. (1972a, Edit.) - Growth centres in regional economic development planning - The Free Press, N.Y.

Hermansen, T. 1971 - Spatial organization and economic development: the scope and task of spatial planning - Institute of Development Studies (Mysore) - India.

Hirschman, A. 1958 - The strategy of economic development - Yale University Press, N. Haven, Connecticut.

International Labour Office 1972 - Employment, income and equality - I.L.O., Geneva.

Isard, W. & Cumberland, J.H. (Edits) 1960 - Regional economic planning: techniques of analysis - Organization for Economic Cooperation and Development (O.E.C.D.).

Kongere, P.C. 1979 - Production and socio-economic aspects of fisheries in the Lake Victoria Basin (Kenya) - Seminar series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Kongstad, P. 1974 - Growth poles and urbanization: a critique of Perroux and Friedman - Antipode, Vol. 6, No. 21, pp. 114-22.

Kuklinski, A.R. (Edit.) 1972 - Growth poles and growth centres in regional planning - Mouton.

McLoughlin, J.B., 1969 - Urban and regional planning: a systems approach - Faber.

Meadows, B.S. 1979 - The quality of water in the Lake Victoria Basin and its protection - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Misra, R.P. 1971 - Growth poles and growth centresin urban and regional planning in India - Institute of Development Studies (Mysore), India.

Moseley, M.J. 1974 - Growth centres in spatial planning - Pergamon Press.

Muituti, W. 1979 - The Lake Victoria Basin: ecological land productivity as a critical policy issue - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi.

Myrdal, G. 1957 - Economic theory and underdeveloped regions - Methuen, London.

Nyambok, I.O. 1979 - Mineral resources of the Lake Victoria Basin - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Obara, D.A. 1979 - Cotton production in the Lake Victoria Basin of Kenya - Seminar Series on Lake Victoria Basin Development Authority - I.D.S. University of Nairobi, Nairobi.

Odada, J.E.O. 1979 - The role of sugar industry in Kenyan economy: a case stud of the Lake Victoria Basin Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Odenyo, V.A.O. and D'Costa, V.P.F.X. 1979 - The soils of the Lake Victoria Basin - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Odero, N. 1979 - Fish species, distribution and abundance in Lake Victoria - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Ogendo, R.B. 1972 - Industrial geography of Kenya - East African Publishing House, Nairobi.

Ongwenyi, G.S. 1979 - Water resources of the Lake Victoria Basin of Kenya - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Ouchо, J.O. 1979 - Population and its implications for resource development in the Lake Victoria Basin - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Owino, F. 1979 - Forestry and wildlife in the Lake Victoria Basin - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Oyugi Aseto, 1979 - The application of the concept of comprehensive and integrated regional planning to the development of Lake Victoria Basin - Seminar Series on Lake Victoria Basin Development Authority - I.D.S., University of Nairobi, Nairobi.

Oyugi, W.O. 1979 - A recommended institutional framework for the Lake Victoria Basin Development Authority - Seminar Series on Lake Victoria Basin Development Authority - I.D.S. University of Nairobi, Nairobi.

Perroux, F. 1955 - Note sur la notion des poles de croissance - Economic Appliquee, 1 et 2 (Paris).

Slater, D. 1975 - Underdevelopment and spatial inequality: approaches to the problem of urban and regional planning in the Third World - Progress in Planning, Vol. 4, No. 2.

Index No.	Name of Industry	ISIC Code	Factories			Operatives			% Basin's Total	
			Rural	Urban	Total	Rural	Urban	Total	Factories	Operatives
1	Meat Products Processing	201	1	3	4	45	92	137	0.30	0.25
2	Dairy Products Processing	202	16	11	27	273	398	671	2.01	1.21
3	Fruit & vegetable canning and soft drinks processing	203; 214	10	11	21	396	337	733	1.57	1.32
4	Grain milling	205	23	28	51	357	902	1259	3.81	2.27
5	Miscellaneous food products processing	204; 209	11	24	35	439	605	1044	2.61	1.88
	Bakery products processing	206	3	22	25	36	512	548	1.37	0.99
	Chocolate and Sugar Confectionery processing	208	-	3	3	-	44	44	0.22	0.08
8	Sugar processing	207	91	1	92	3771	10	3781	6.87	6.80
9	Tea processing	209	84	2	86	6019	80	6099	6.42	10.98
10.	Coffee processing	(200) 209	98	3	101	1684	69	1753	7.54	3.16
11	Brewing and blending of alcoholic beverages	211-213	3	6	9	58	175	233	0.67	0.42
Total	Agricultural food processing industries		340	114	454	13078	3224	16302	33.88	29.34

Table 3. Agricultural Food Processing industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

Index No.	Name of industry	ISIC Code	Factories			Operatives			% Basin's Total	
			Rural	Urban	Total	Rural	Urban	Total	Factories	Operatives
12	Tobacco processing	220	-	-	-	-	-	-	-	-
13	Soap and edible oils processing	312; (315)	-	12	12	-	385	385	0.90	0.69
14	Miscellaneous vegetable chemical products processing (e.g pyrethrum)	316 part of 319	3	6	9	64	324	388	0.67	0.70
15	Footwear fabrication and repair	241	-	14	14	-	139	139	1.04	0.25
16	Tanning extract, leather tanning and fabrication of non-footwear leather goods	291;299 (314)	5	14	19	306	1287	1593	1.42	2.87
17	Fibre processing	231;233	43	16	59	5997	2212	8209	4.40	14.77
18	Textile manufacture	232;234; 239	2	5	7	794	2364	3158	0.52	5.68
19	Clothing fabrication	243;244	4	47	51	33	784	817	3.81	1.47
20	Sawmilling	251	78	60	138	5065	2209	7274	10.30	13.09
21	Miscellaneous wood products manufacture	259	4	6	10	755	518	1273	0.75	2.29
22	Furniture and fixtures fabrication	260	14	79	93	196	1109	1305	6.94	2.35
23	Pulp, paper & paper products manufacture	271;272	1	1	2	80	1040	1120	0.15	2.02
Total	Agricultural non-food manufacturing industries		154	260	414	13290	12371	25661	30.90	46.18
GRAND TOTAL	Agricultural manufacturing Total		494	374	868	26968	15595	41963	64.78	75.52

Table 4: Agricultural non-food manufacturing industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

Index No.	Name of industries	ISIC Code	FACTORIES			OPERATIVES			% Basin's Total	
			Rural	Urban	Total	Rural	Urban	Total	Factories	Operatives
24	Basic non-vegetable industrial chemicals processing	311	7	3	10	508	48	556	0.75	1.00
25	Miscellaneous non-vegetable chemical products processing	313;part of 319;356	-	17	17	-	206	206	1.27	0.37
26	Clay and concrete products manufacture	311;333; 339	17	18	35	266	688	954	2.61	1.72
27	Cement, glass and allied products manufacture	332; 334	1	11	12	55	293	348	0.90	0.63
30	Rubber products fabrication and repair (e.g tyre retreading)	300	-	9	9	-	109	109	0.67	0.20
34	Motor vehicle assembly	383	1	4	5	8	47	55	0.37	0.10
38	Generation and supply of electricity	511	5	8	13	47	306	353	0.97	0.63
39	Processing and supply of water	521	10	15	25	153	348	501	1.87	0.90
Total	Non-agricultural manufacturing industries		41	85	126	1037	2045	3082	9.40	5.55

Table 5: Non-agricultural manufacturing industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

Index No.	Name of industries	ISIC Code	FACTORIES			OPERATIVES			% Basin's Total	
			Rural	Urban	Total	Rural	Urban	Total	Factories	Operatives
28	Printing and Publishing	280	4	18	22	71	428	499	1.64	0.90
29	Electrical machinery and repair	370	-	3	3	-	85	85	0.22	0.15
31	Non-electrical machinery and repair	360;386; 389	-	14	14	-	306	306	1.04	0.55
32	Boat, steamer and ship repair	381	-	1	1	-	260	260	0.07	0.47
33	Railway services	382	-	5	5	-	979	979	0.37	1.76
35	Motor vehicle repair	384	20	157	177	584	4084	4668	13.21	8.40
36	Metal products (including some manufacture)	350	4	17	21	36	1253	1289	1.57	2.32
37	Miscellaneous service industries	391-399	11	92	103	304	2125	2429	7.69	4.37
Total	Service industries		39	307	346	995	9520	10515	25.82	18.92
GRAND TOTAL	Non-agricultural manufacturing & service industries		80	392	472	2032	11565	13597	35.22	24.47

Table 6: Service industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

LAKE VICTORIA BASIN DIST. AND PROVINCES		1	2	3	4	5	6	7	8	9	10	11	AFP Total
Siaya District		-	2	-	1	1	-	-	2	-	-	-	6
Kisumu District		-	7	9	7	6	5	3	62	-	5	1	105
South Nyanza District		-	2	-	-	1	-	-	12	-	5	-	20
K i District		-	-	1	2	-	1	-	1	6	23	-	34
Nyanza Province		-	11	10	10	8	6	3	77	6	33	1	165
Busia District		-	-	-	-	-	-	-	-	-	-	-	-
Bungoma District		-	-	-	6	-	1	-	1	-	9	-	17
Kakamega District		-	1	1	9	-	3	-	12	2	4	-	32
Western Province		-	1	1	15	-	4	-	13	2	13	-	49
West Pokot District		-	-	-	-	-	-	-	-	-	-	-	-
Trans Nzoia District		-	1	3	5	1	2	-	-	1	34	2	49
Elgeyo Marakwet District		-	-	-	-	-	-	-	-	-	-	-	-
Uasin Gishu District		1	7	1	6	2	3	-	-	-	2	2	24
N ii District		-	-	-	-	-	-	-	-	25	4	-	29
Kericho District		-	1	2	-	1	2	-	1	52	7	-	66
Nakuru District		3	6	4	15	23	8	-	1	-	8	4	72
Narok District		-	-	-	-	-	-	-	-	-	-	-	-
Part of R.Valley Province		4	15	10	26	27	15	-	2	78	55	8	240
Nyanza and Western Provinces (Political Lake Basin)		-	12	11	25	8	10	3	90	8	46	1	214
Lake Victoria Basin districts total (Economic region Lake Basin)		4	27	21	51	35	25	3	92	86	101	9	454
As percentage of Lake Victoria Basin districts total		0.30	2.01	1.57	3.81	2.61	1.87	0.22	6.87	6.42	7.54	0.67	33.88
All (relevant) Kenya districts total		15	64	63	105	114	88	13	97	107	566	39	1275
As percentage of all (relevant) Kenya district Total	Single Industry	26.67	42.19	33.33	46.79	30.70	28.41	23.08	94.84	80.37	17.84	23.08	35.61
	All Industries	0.09	0.60	0.46	1.13	0.77	0.55	0.07	2.04	1.90	2.24	0.20	10.05

Table 7.1: Factories, each employing 5 or more operatives, involved in all manufacturing and service industries in Lake Victoria Basin districts (both political and economic regional versions of the Lake Basin).

LAKE VICTORIA BASIN DIST. AND PROVINCES		12	13	14	15	16	17	18	19	20	21	22	23	ANFP Total	AGM Total
Siaya Dsitrict		-	-	-	-	-	1	-	-	-	-	-	-	1	7
Kisumu District		-	7	-	2	5	14	1	12	4	-	30	-	75	180
South Nyanza District		-	-	-	-	-	5	-	1	-	-	1	-	7	2
Kisii District		-	-	-	2	-	-	-	-	-	1	3	-	6	40
Nyanza Province		-	7	-	4	5	20	1	13	4	1	34	-	89	254
Busia District		-	-	-	-	-	3	-	-	-	-	-	-	3	3
Bungoma District		-	-	-	-	-	3	-	-	4	-	1	1	9	26
Kakamega District		-	-	-	1	3	-	-	8	6	-	2	-	20	52
Western Province		-	-	-	1	3	6	-	8	10	-	3	1	32	81
West Pokot District		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trans Nzoia District		-	1	-	3	-	1	-	6	12	-	5	-	28	77
Elgeyo Marakwet District		-	-	-	-	-	-	-	-	1	-	-	-	1	1
Uasin Gishu District		-	1	-	1	4	7	2	9	30	2	15	-	71	95
Nandi District		-	-	-	-	-	-	-	-	1	-	-	-	1	30
Kericho District		-	-	1	-	1	3	-	2	1	-	7	1	16	8
Nakuru District		-	3	8	5	6	22	4	13	78	7	29	-	175	247
Narok District		-	-	-	-	-	-	-	-	1	-	-	-	1	1
Part of Rift Valley Province		-	5	9	9	11	33	6	30	124	9	56	1	293	533
Nyanza and Western Province (Political Lake Basin)		-	7	-	5	8	26	1	21	14	1	37	1	121	335
Lake Victoria Basin districts total (Economic region L.B.)		-	12	9	14	19	59	7	51	138	10	93	2	414	868
As percentage of Lake Victoria Basin districts total		-	0.90	0.67	1.04	1.42	4.40	0.52	3.81	10.30	0.75	6.94	0.15	30.90	64.78
All (relevant) Kenya districts total		5	41	18	71	44	142	33	308	250	36	389	29	1366	2641
As percentage of all (relevant) Kenya districts total	Single industry		29.27	50.00	19.72	43.18	41.55	21.21	16.56	55.20	27.78	23.91	6.90	30.31	32.[illegible]
	All industries		0.27	0.20	0.31	0.42	1.31	0.15	1.13	3.05	0.22	2.06	0.04	9.16	

Table 7.2: Factories, each employing 5 or more operatives, involved in all manufacturing and service industries in Lake Victoria Basin districts (both political and economic regional versions of the Lake Basin).

LAKE VICTORIA BASIN DIST. AND PROVINCES	24	25	26	27	30	34	38	39	NAM Total	28	29	31	32	33	35	36	37	S Total	NAM & S Total
Siaya District	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1
Kisumu District	6	3	15	3	4	3	2	3	39	6	1	8	1	2	41	7	37	103	142
South Nyanza District	-	-	-	-	-	-	2	1	3	3	-	-	-	-	3	1	-	7	10
Kisii District	-	-	1	-	-	-	-	1	2	-	-	-	-	-	10	-	-	10	12
Nyanza Province	6	3	16	3	4	3	4	6	45	9	1	8	1	2	54	8	37	120	165
Busia District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1
Bungoma District	-	-	-	-	-	-	-	1	1	-	-	-	-	-	2	-	-	2	3
Kakamega District	-	-	2	-	-	-	-	-	2	2	-	1	-	-	7	-	1	11	13
Western Province	-	-	2	-	-	-	-	1	3	2	-	1	-	-	10	-	1	14	17
West Pokot District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trans Nzoia District	-	1	4	1	-	-	1	3	10	3	-	2	-	-	17	2	14	38	48
Elgeyo Marakwet District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uasin Gishu District	2	3	3	2	-	-	2	-	12	3	-	1	-	1	29	1	16	51	63
Nandi District	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1
Kericho District	1	1	4	4	-	2	5	2	19	1	-	1	-	-	16	1	9	28	47
Nakuru District	1	9	6	2	5	-	1	12	36	4	2	1	-	2	49	9	26	93	129
Narok District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	2
Part of Rift V.Province	4	14	17	9	5	2	9	18	78	11	2	5	-	3	113	13	65	212	290
Nyanza & Western Prov. (Political Lake Basin)	6	3	18	3	4	3	4	7	48	11	1	9	1	2	64	8	38	134	182
Lake V.Basin districts total (Econ.region LB)	10	17	35	12	9	5	13	25	126	22	3	14	1	5	177	21	103	346	472
As percentage L.V. Basin districts total	0.75	1.27	2.61	0.90	0.67	0.37	0.97	1.87	9.40	1.64	0.22	1.04	0.07	0.37	13.21	1.57	7.69	25.82	35.22
All (relevant) Kenya districts total	36	131	76	50	34	38	38	55	458	145	60	60	17	28	540	140	429	1419	1877
As percentage of all (relevant) Kenya Districts total — Single industry	27.78	12.98	46.05	24.00	26.47	13.16	34.21	45.45	27.51	15.17	5.00	23.33	5.88	17.86	32.78	15.00	24.01	24.38	25.15
As percentage of all (relevant) Kenya Districts total — All industries	0.22	0.38	0.77	0.27	0.20	0.11	0.29	0.55	2.79	0.49	0.07	0.31	0.02	0.11	3.92	0.46	2.28	7.66	10.45

Table 7.3: Factories, each employing 5 or more operatives, involved in all manufacturing and service industries in Lake Victoria Basin districts (both political and economic regional versions of the Lake Basin).

LAKE VICTORIA BASIN DIST. AND PROVINCES	All industry total			As percentage of Basin's Total	As percentage of Kenya's Total
	Rural	Urban	Total		
Siaya District	8	-	8	0.60	0.18
Kisumu District	97	225	322	24.03	7.13
South Nyanza District	26	11	37	2.76	0.82
Kisii District	23	29	52	3.88	1.14
Nyanza Province	154	265	419	31.27	9.27
Busia District	4	-	4	0.30	0.09
Bungoma District	28	1	29	2.16	0.64
Kakamega District	36	29	65	4.85	1.44
Western Province	68	30	98	7.31	2.17
West Pokot District	-	-	-	-	-
Trans Nzoia District	49	76	125	9.33	2.77
Elgeyo Marakwet District	1	-	1	0.07	0.02
Uasin Gishu District	44	144	158	11.79	3.50
Nandi District	31	-	31	2.32	0.69
Kericho District	93	36	129	9.63	2.85
Nakuru District	124	252	376	28.06	8.32
Narok District	3	-	3	0.22	0.07
Part of Rift Valley Province	345	478	823	61.42	18 22
Nyanza and Western Provinces (Political Lake Basin)	222	295	517	38.58	11.44
Lake V. Basin districts total (Economic region Lake Basin)	567	773	1340	100.00	29.66
As percentage of Lake Victoria Basin districts total	42.31	27.69	100.00	-	-
All (relevant) Kenya districts total	1416	3102	4518	337.18	100.00
As percentage of all (relevant) Kenya districts total — Single Industry	40.04	24.92	29.66	-	-
As percentage of all (relevant) Kenya districts total — All Industries	12.55	17.11	29.66	-	-

Table. 7.4: Factories, each employing 5 or more operatives, involved in all manufacturing and services industries in Lake Victoria Basin districts (both Political and economic regional versions of the Lake Basin).

LAKE VICTORIA BASIN DIST. AND PROVINCES		1	2	3	4	5	6	7	8	9	10	11	AFP Total
Siaya District		-	20	-	12	12	-	-	71	-	-	-	115
Kisumu District		-	150	181	173	172	99	44	2767	-	63	20	3669
South Nyanza District		-	20	-	-	14	-	-	274	-	102	-	410
Kisii District		-	-	20	28	-	20	-	22	309	583	-	
Nyanza Province		-	190	201	213	198	119	44	3134	309	748	20	5176
Busia District		-	-	-	-	-	-	-	-	-	-	-	-
Bungoma District		-	-	-	95	-	20	-	16	-	205	-	336
Kakamega District		-	15	12	126	-	50	-	586	41	64	-	894
Western Province		-	15	12	221	-	70	-	602	41	269	-	1230
West Pokot District		-	-	-	-	-	-	-	-	-	-	-	-
Trans Nzoia District		-	30	21	107	12	29	-	-	12	366	43	620
Elgeyo Marakwet District		-	-	-	-	-	-	-	-	-	-	-	-
Uasin Gishu District		45	238	30	391	19	41	-	-	-	16	55	835
Nandi District		-	-	-	-	-	-	-	-	1205	73	-	1278
Kericho District		-	30	214	-	17	17	-	35	4532	88	-	4933
Nakuru District		92	168	255	327	798	272	-	10	-	193	115	2230
Narok District		-	-	-	-	-	-	-	-	-	-	-	-
Part of Rift Valley Province		137	466	520	825	846	359	-	45	5749	736	213	9896
Nyanza and Western Provinces (Political Lake Basin)		-	205	213	434	198	189	44	3736	350	1017	20	6406
Lake Victoria Basin districts total (Econ. region Lake Basin)		137	671	733	1259	1044	548	44	3781	6099	1753	233	16302
As percentage of Lake Victoria Basin districts total		0.25	1.21	1.32	2.27	1.88	0.99	0.08	6.80	10.98	3.16	0.42	29.34
All (relevant) Kenya districts total		1750	1583	3448	3592	3418	2612	266	4565	7441	14778	2718	46171
As percentage of all (relevant) Kenya districts total	Single industry	7.83	42.39	21.26	35.05	30.54	20.98	16.54	82.83	81.96	11.86	8.57	35.31
	All industries	0.07	0.34	0.38	0.65	0.54	0.28	0.02	1.94	3.13	0.90	0.12	8.37

Tables. 8.1: Operatives employed in the manufacturing and service industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

LAKE VICTORIA BASIN DIST. AND PROVINCES		12	13	14	15	16	17	18	19	20	21	22	23	ANFP Total	AGM Total
Siaya District		-	-	-	-	-	175	-	-	-	-	-	-	175	290
Kisumu District		-	208	-	20	84	1802	600	153	294	-	563	-	3724	7393
South Nyanza District		-	-	-	-	-	849	-	12	-	-	20	-	881	1291
Kisii District		-	-	-	16	-	-	-	-	-	12	35	-	63	1045
Nyanza Province		-	208	-	36	84	2826	600	165	294	12	618	-	4843	10019
Busia District		-	-	-	-	-	338	-	-	-	-	-	-	338	338
Bungoma District		-	-	-	-	-	150	-	-	124	-	8	1040	1322	1658
Kakamega District		-	-	-	8	75	-	-	113	172	-	20	-	388	1282
Western Province		-	-	-	8	75	488	-	113	296	-	28	1040	2048	3278
West Pokot District		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trans Nzoia District		-	8	-	28	-	175	-	56	677	-	49	-	993	1613
Elgeyo Marakwet District		-	-	-	-	-	-	-	-	100	-	-	-	100	100
Uasin Gishu District		-	20	-	8	1201	772	1700	244	1501	134	153	-	5733	6568
Nandi District		-	-	-	-	-	-	-	-	150	-	-	-	150	1428
Kericho District		-	-	22	-	110	195	-	13	55	-	131	80	606	5539
Nakuru District		-	149	366	59	123	3753	858	226	4121	1127	326	-	11108	13338
Narok District		-	-	-	-	-	-	-	-	80	-	-	-	80	80
Part of Rift V.Province		-	177	388	95	1434	4895	2558	539	6684	1261	659	80	18770	28666
Nyanza and Western Provinces (Political Lake Basin)		-	208	-	44	159	3314	600	278	590	12	646	1040	6891	13297
Lake Victoria Basin districts total (Econ. region Lake Basin)		-	385	388	139	1593	8209	3158	817	7274	1273	1305	1120	25661	41963
As percentage of Lake Victoria Basin districts total		-	0.69	0.70	0.25	2.87	14.77	5.68	1.47	13.09	2.29	2.35	2.02	46.18	75.52
All (relevant) Kenya districts total		1298	1488	776	1863	3136	18632	8466	7080	12565	2805	7616	2263	67988	114159
As percentage of all (relevant) Kenya districts total	Single industry	-	25.87	50.00	7.46	50.80	44.06	37.30	11.54	57.89	45.38	17.13	49.49	37.74	
	All industries	-	0.20	0.20	0.07	0.82	4.22	1.62	0.42	3.74	0.65	0.67	0.57	13.18	21.56

Table 8.2: Operatives employed in the manufacturing and service industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

LAKE VICTORIA BASIN DIST. AND PROVINCES	24	25	26	27	30	34	38	39	NAM Total	28	29	31	32	33	35	36	37	S Total	NAM &S Total
Siaya District	-	-	-	-	-	-	-	10	10	-	-	-	-	-	-	-	-	-	10
Kisumu District	178	35	449	82	65	39	105	100	1053	144	12	124	260	279	736	138	1189	2882	3935
South Nyanza District	-	-	-	-	-	-	31	10	41	60	-	-	-	-	180	15	-	255	296
Kisii District	-	-	10	-	-	-	-	12	22	-	-	-	-	-	115	-	-	115	137
Nyanza Province	178	35	459	82	65	39	136	132	1126	204	12	124	260	279	1031	153	1189	3252	4378
Busia District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	10	10
Bungoma District	-	-	-	-	-	-	-	14	14	-	-	-	-	-	18	-	-	18	32
Kakamega District	-	-	16	-	-	-	-	-	16	16	-	8	-	-	142	-	10	176	192
Western Province	-	-	16	-	-	-	-	14	30	16	-	8	-	-	170	-	10	204	234
West Pokot District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trans Nzoia District	-	8	104	12	-	-	45	90	259	58	-	42	-	-	453	28	292	873	1132
Elgeyo Marakwet District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Uasin Gishu District	325	19	107	65	-	-	110	-	626	40	-	75	-	450	710	12	279	1566	2192
Nandi District	-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	-	-	-	6
Kericho District	8	5	42	126	-	16	40	16	253	12	-	5	-	-	588	8	187	800	1053
Nakuru District	45	139	226	63	44	-	22	243	782	169	73	52	-	250	1700	1088	472	3804	4586
Narok District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	-	16	16
Part of R. Valley Prov.	378	171	479	266	44	16	217	355	1926	279	73	174	-	700	3467	1136	1230	7059	8985
Nyanza & Western Prov. (Political L. Basin)	178	35	475	82	65	39	136	146	1156	220	12	132	260	279	1201	153	1199	3456	4612
Lake V.Basin districts total (Econ. region LB)	556	206	954	348	109	55	353	501	3082	499	85	306	260	979	4668	1289	2429	10515	13597
As percentage of Lake V. Basin districts total	1.00	0.37	1.72	0.63	0.20	0.10	0.63	0.90	5.55	0.90	0.15	0.55	0.47	1.76	8.40	2.32	4.37	18.92	24.47
All (relevant) Kenya districts total	4090	3135	4096	3670	853	2223	1483	791	20341	5331	2551	2499	1232	8100	17050	7723	15690	60176	80517
As percentage of all (relevant) Single industry	13.59	6.57	23.29	9.48	12.78	2.47	23.80	63.34	15.15	9.36	3.33	12.24	21.10	12.09	27.38	16.69	15.48	17.47	16.89
As percentage of all (relevant) All industries	0.29	0.11	0.49	0.18	0.06	0.03	0.18	0.26	1.58	0.26	0.04	0.16	0.13	0.50	2.40	0.66	1.25	5.40	6.98

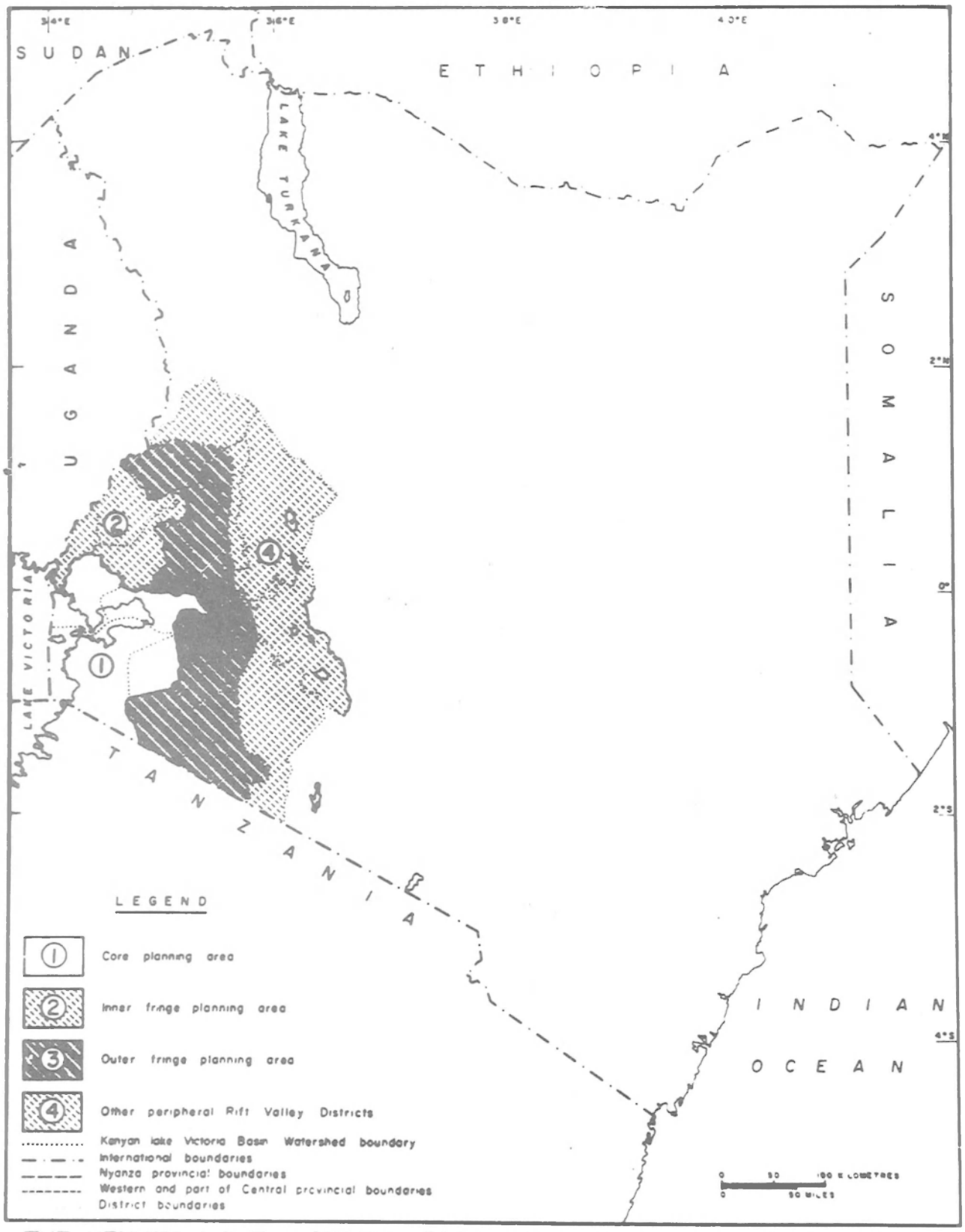
Table 8.3: Operatives employed in the manufacturing and service industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

LAKE VICTORIA BASIN DIST. AND PROVINCES		All Industries total Rural	Urban	Total	As percentage of Basin's total	As percentage of Kenya's total
Siaya District		300	-	300	0.54	0.16
Kisumu District		3902	7426	11328	20.39	5.82
South Nyanza District		1076	511	1587	2.86	0.81
Kisii District		844	338	1182	2.13	0.61
Nyanza Province		6122	8275	14397	25.92	7.40
Busia District		348	-	348	0.63	0.18
Nungoma District		650	1040	1690	3.04	0.87
Kakamega District		1033	441	1474	2.65	0.76
Western Province		2031	1481	3512	6.32	1.80
West Pokot District		-	-	-	-	-
Trans Nzoia District		1131	1614	2745	4.94	1.41
Elgeyo Marakwet District		100	-	100	0.18	0.05
Uasin Gishu District		2556	6204	8760	15.77	4.50
Nandi District		1434	-	1434	2.58	0.74
Kericho District		5955	737	6592	11.86	3.39
Nakuru District		8975	8949	17924	32.26	9.21
Narok District		96	-	96	0.17	0.05
Part of R.V. Province		20247	17404	37651	67.76	19.34
Nyanza & Western Prov. (Political Lake Basin)		8153	9756	17909	32.24	9.20
Lake V. Basin districts total (Econ. region LB)		28400	27160	55560	100.00	28.54
% percentage of Lake V. Basin districts total		51.11	48.89	100.00	-	-
All (relevant) Kenya districts total		65768	128908	194676	350.38	100.00
As percentage of all (relevant) Kenya districts total	Single industry	43.18	21.07	28.54	-	-
	All industries	14.59	13.95	28.54	-	-

Table 8.4: Operatives employed in the manufacturing and service industries (in factories each employing 5 or more operatives) in Lake Victoria Basin districts.

Table 9: Industrial employment by factory size-groups in Lake Victoria Basin.

LAKE VICTORIA BASIN DIST & PROV.	F 5-19	A 20-49	C 50-99	T 100-199	O 200-499	R 500-999	I 1000-1999	E 2000+	S Total	O 5-19	P 20-49	E 50-99	R 100-199	A 200-499	T 500-999	I 1000-1999	V 2000+	E	S Total
Siaya District	5	2	-	1	-	-	-	-	8	54	71	-	175	-	-	-	-		300
Kisumu District	190	87	30	7	4	3	1	-	322	2132	2287	1940	1164	1005	1700	1100	-		11328
South N. District	17	13	3	3	1	-	-	-	37	216	356	221	492	302	-	-	-		1587
Kisii District	22	26	4	-	-	-	-	-	52	251	655	276	-	-	-	-	-		1182
Nyanza Province	234	128	37	11	5	3	1	-	419	2653	3369	2437	1831	1307	1700	1100	-		14397
Busia District	1	-	-	3	-	-	-	-	4	10	-	-	338	-	-	-	-		348
Bungoma District	12	15	1	-	-	-	1	-	29	135	446	69	-	-	-	1040	-		1690
Kakamega District	39	24	1	-	1	-	-	-	65	422	686	60	-	306	-	-	-		1474
Western Province	52	39	2	3	1	-	1	-	98	567	1132	129	338	306	-	1040	-		3512
West Pokot District	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Trans Nzoia District	88	22	12	2	1	-	-	-	125	880	593	797	275	200	-	-	-		2745
Elgeyo Marakwet Dist.	-	-	-	1	-	-	-	-	1	-	-	-	100	-	-	-	-		100
Uasin Gishu Dist.	75	46	20	8	7	1	1	-	158	805	1330	1290	1333	2302	500	1200	-		8760
Nandi District	6	13	11	1	-	-	-	-	31	67	480	737	150	-	-	-	-		1434
Kericho District	55	29	23	16	6	-	-	-	129	501	913	1606	2219	1353	-	-	-		6592
Nakuru District	174	114	42	31	12	1	2	-	376	1732	3236	2765	4380	3171	540	2100	-		17924
Narok District	2	-	1	-	-	-	-	-	3	16	-	80	-	-	-	-	-		96
Part of Rift Valley Province	400	224	109	59	26	2	3	-	823	4001	6552	7275	8457	7026	1040	3300	-		37651
Nyanza & Western Prov.(Political Lake Basin)	286	167	39	14	6	3	2	-	517	3220	4501	2566	2169	1613	1700	2140	-		17909
Lake V. Basin Dist. Total (Econ. Region Lake Vic. Basin)	686	391	148	73	32	5	5	-	1340	7221	11053	9841	10626	8639	2740	5440	-		55560
As Percentage Lake V.Basin Dist.Total	51.19	29.18	11.05	5.45	2.39	0.37	0.37	-	100.00	13.00	19.89	17.71	19.13	15.55	4.93	9.79	-		100.00
All (relevant) Kenya Dist. Total	2258	1392	456	239	145	16	11	1	4518	24192	39026	29780	34784	41224	9892	12928	2850		194676
As percentage Single grp. of all (relev.)	30.38	28.09	32.46	30.54	22.07	31.25	45.45	-	29.66	29.85	28.32	33.05	30.55	20.96	27.70	42.08	-		28.54
Kenya Dis. All grs.	15.18	8.65	3.28	1.62	0.71	0.11	0.11	-	29.66	3.71	5.68	5.06	5.46	4.44	1.40	2.79	-		28.54



THE KENYAN LAKE VICTORIA BASIN AND ITS VARIOUS FRINGE ZONES

Fig. 1

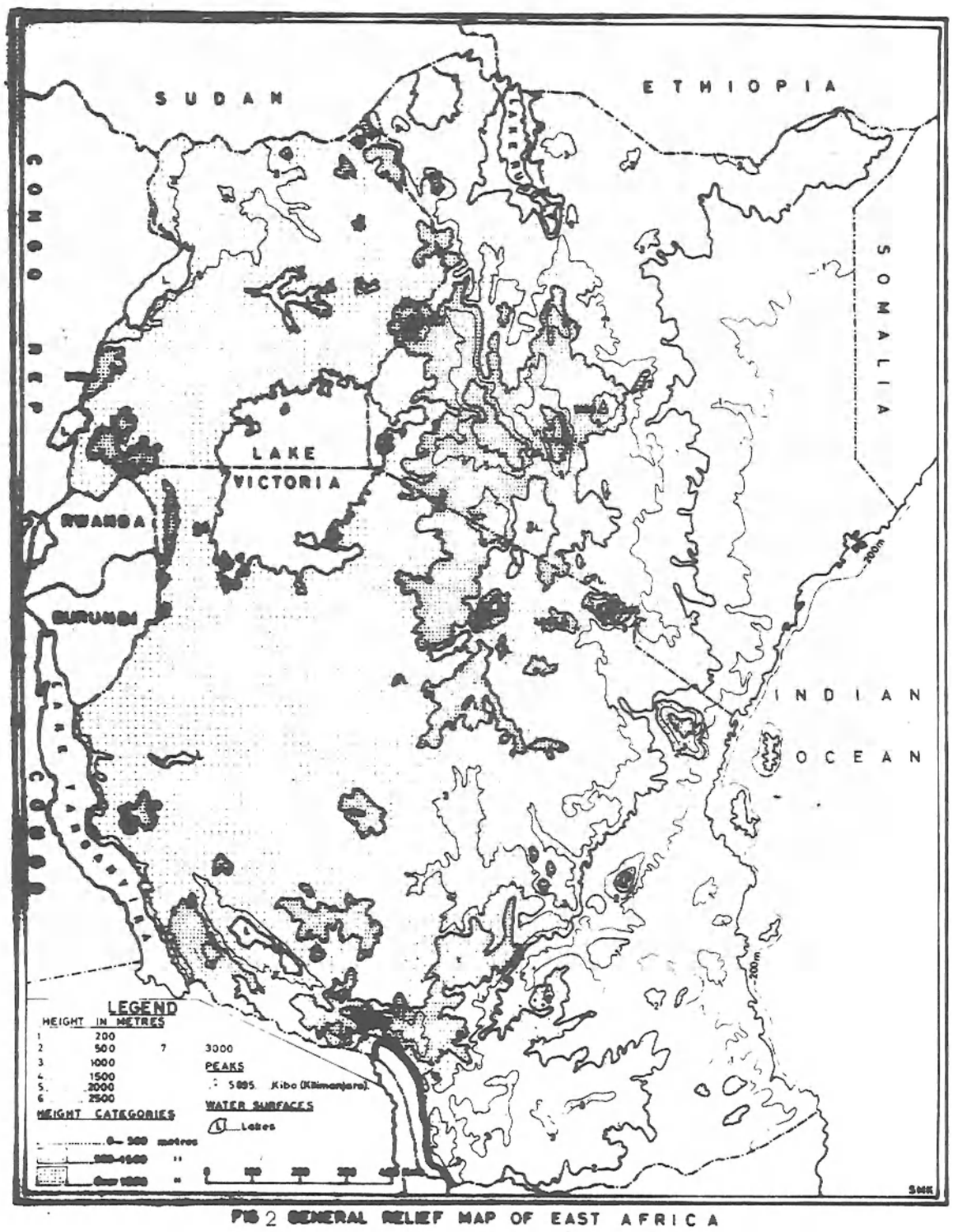


FIG 2 GENERAL RELIEF MAP OF EAST AFRICA

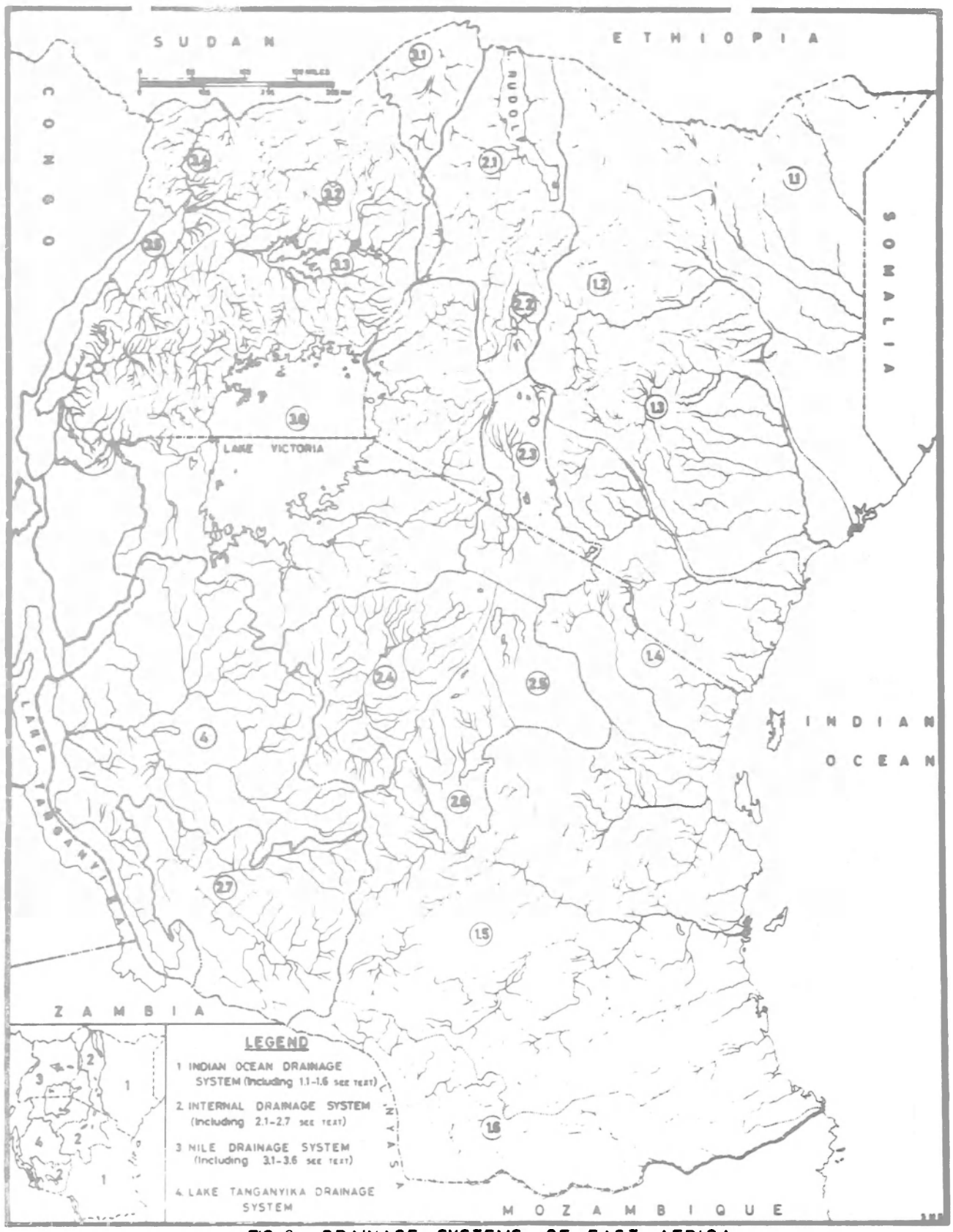


FIG. 3 DRAINAGE SYSTEMS OF EAST AFRICA

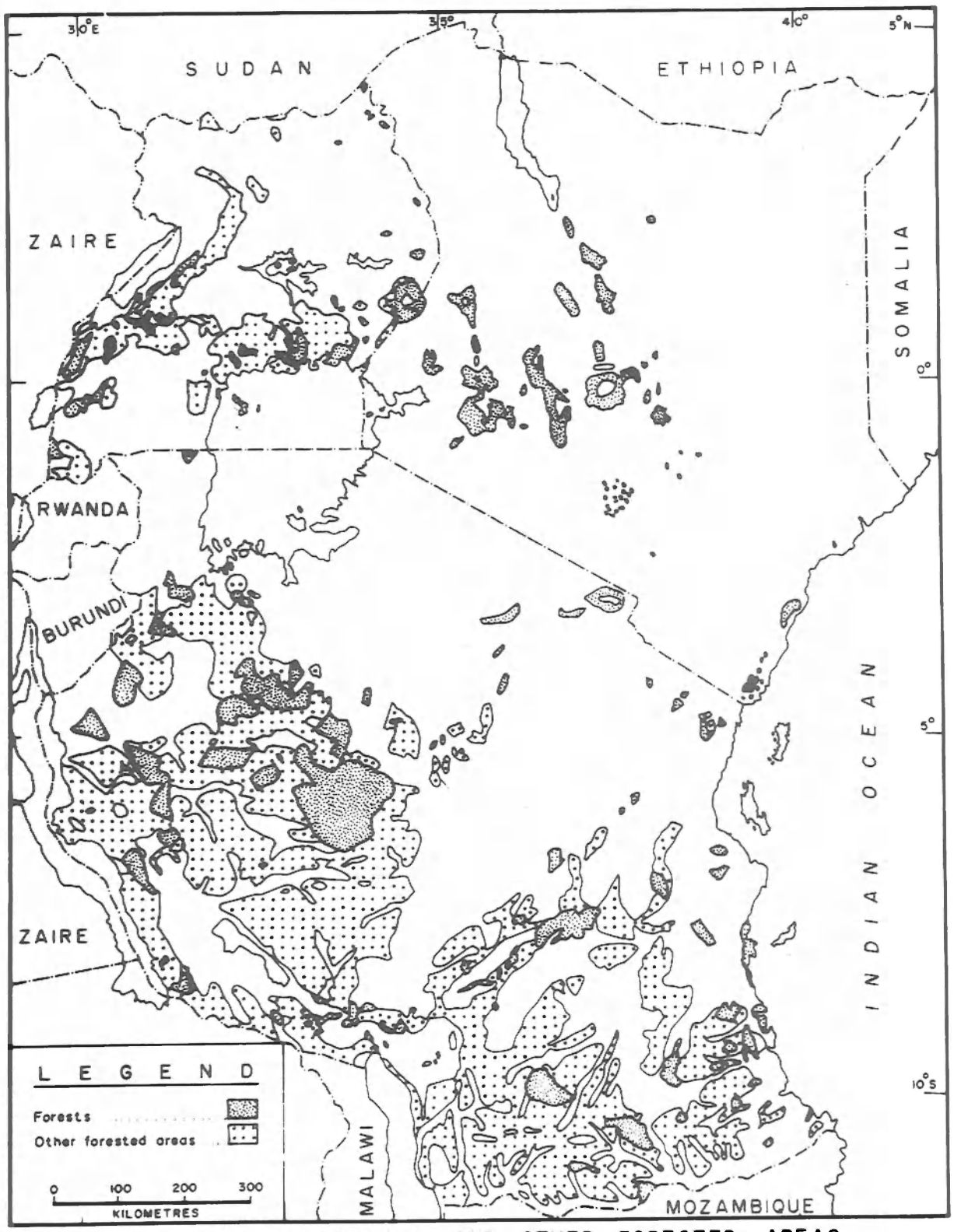


FIG. 4 MAJOR FORESTS AND OTHER FORESTED AREAS

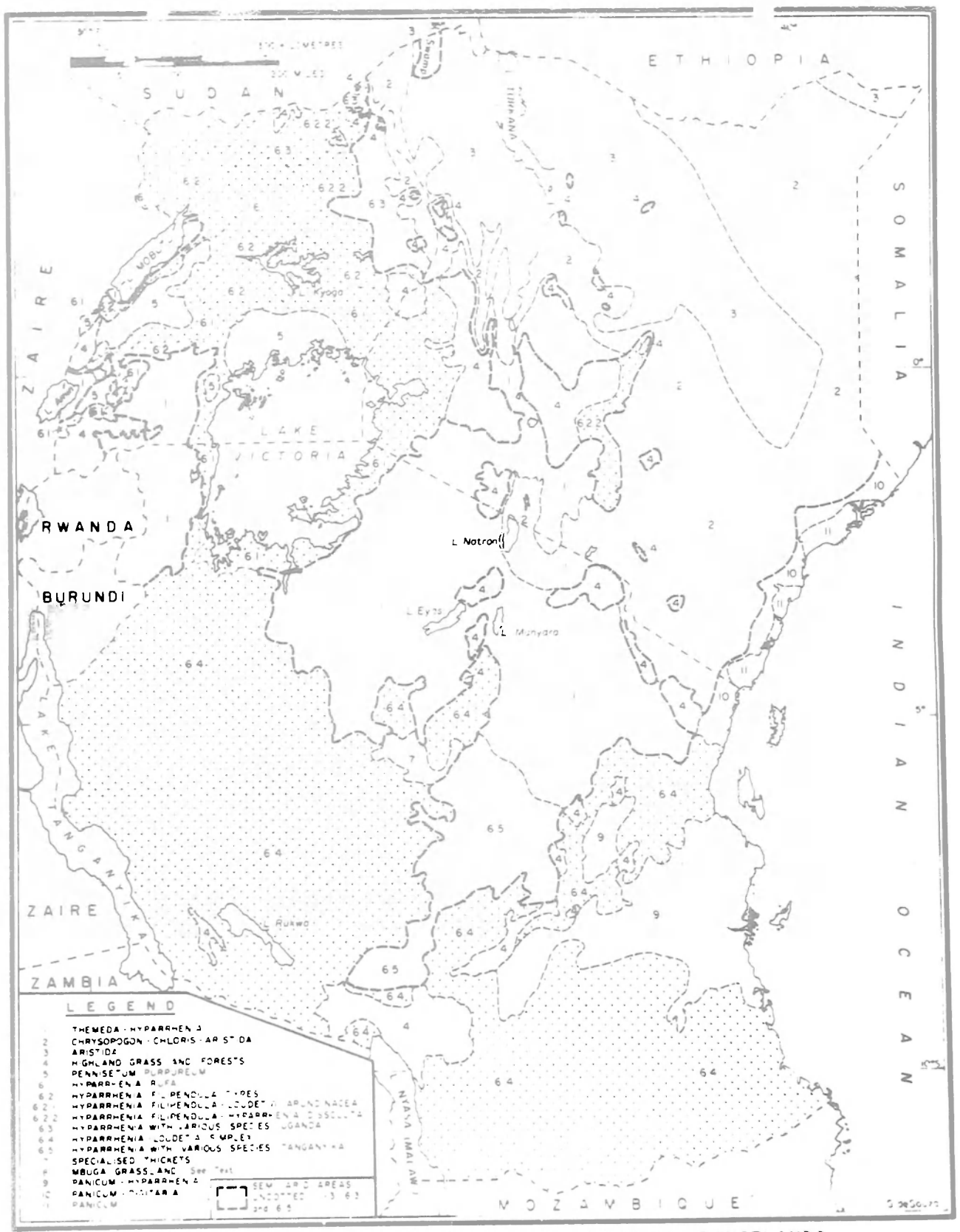


FIG. 5 EAST AFRICA: EXISTING AND POTENTIAL RANGELANDS

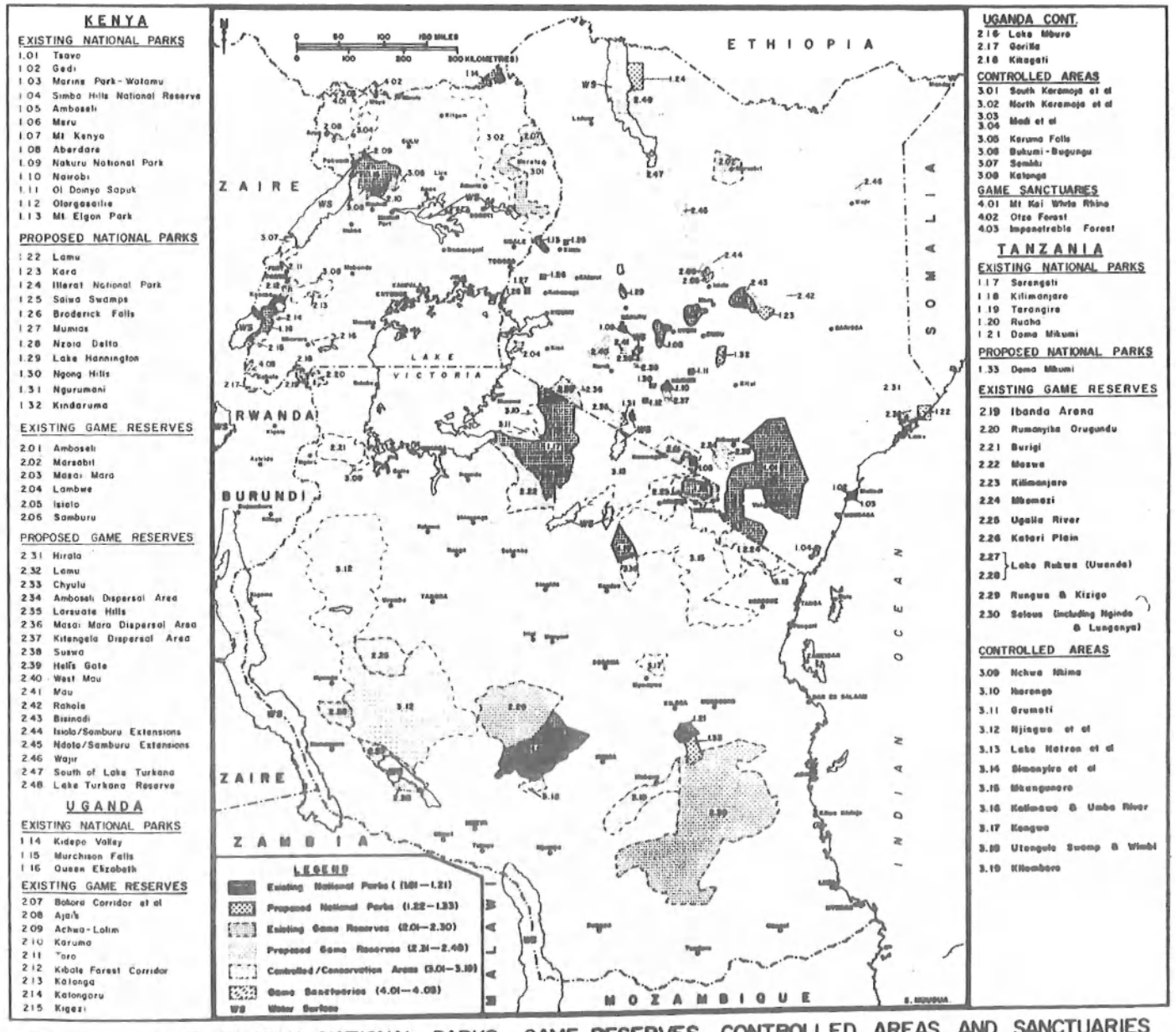


FIG. 6 EAST AFRICAN NATIONAL PARKS, GAME RESERVES, CONTROLLED AREAS AND SANCTUARIES

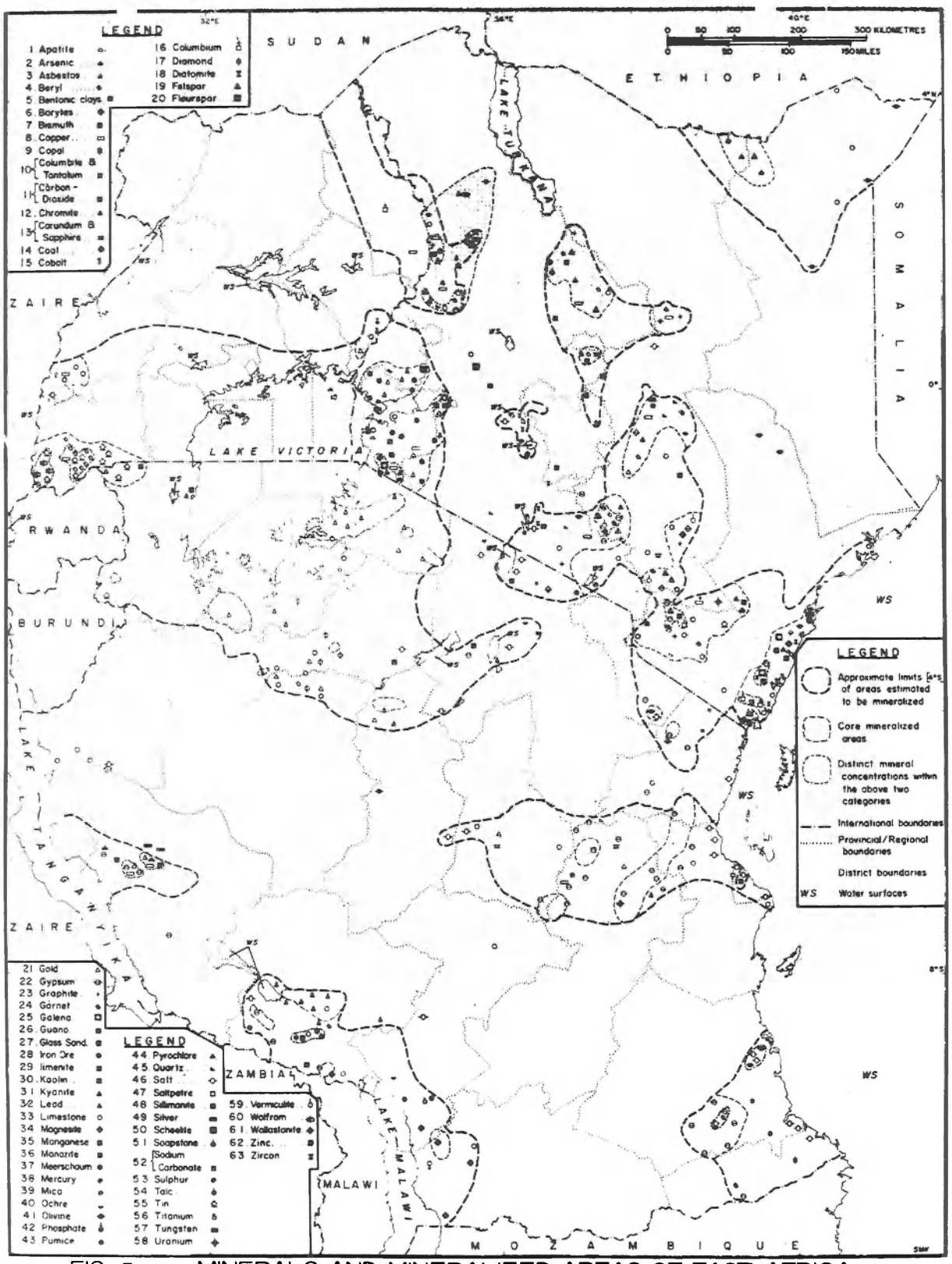


FIG 7 MINERALS AND MINERALIZED AREAS OF EAST AFRICA

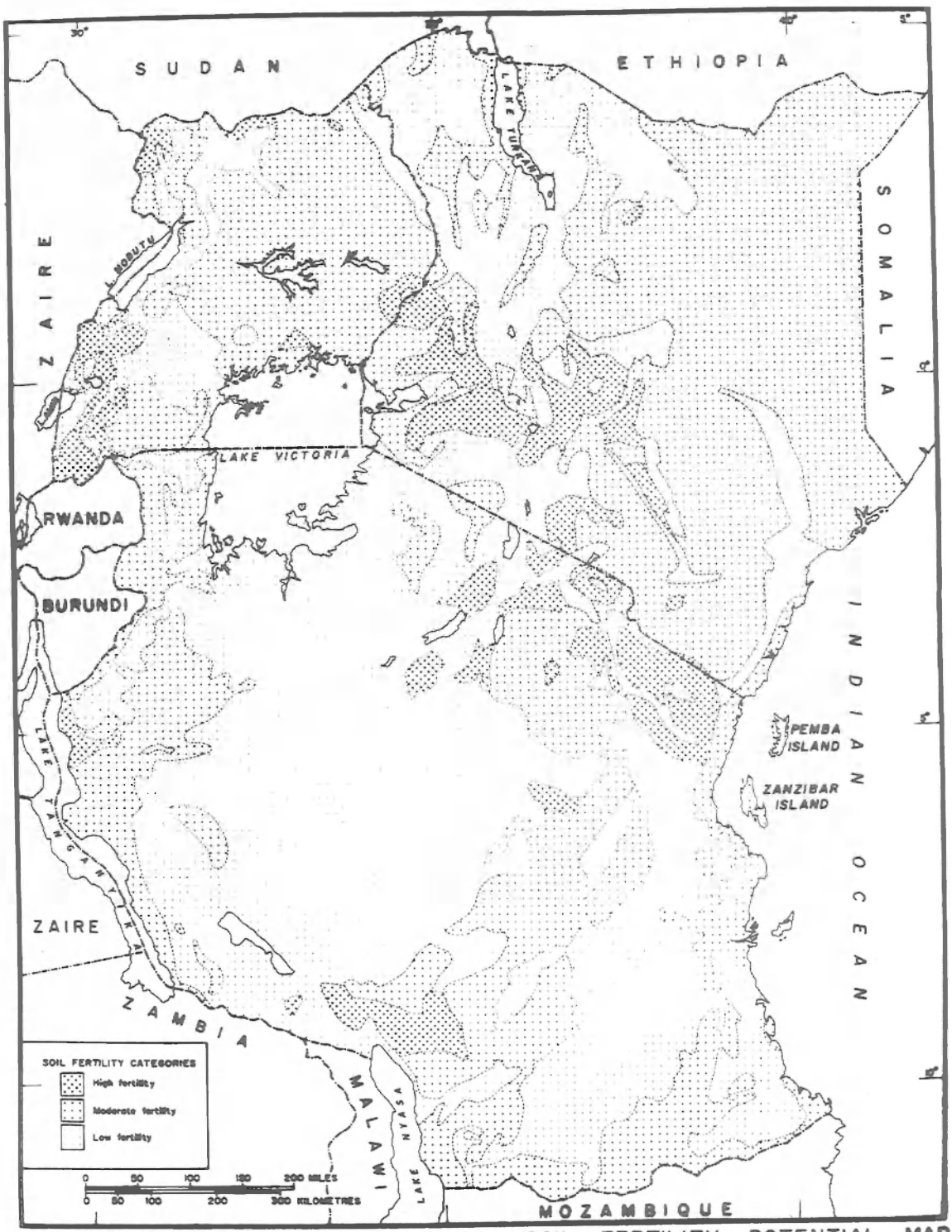
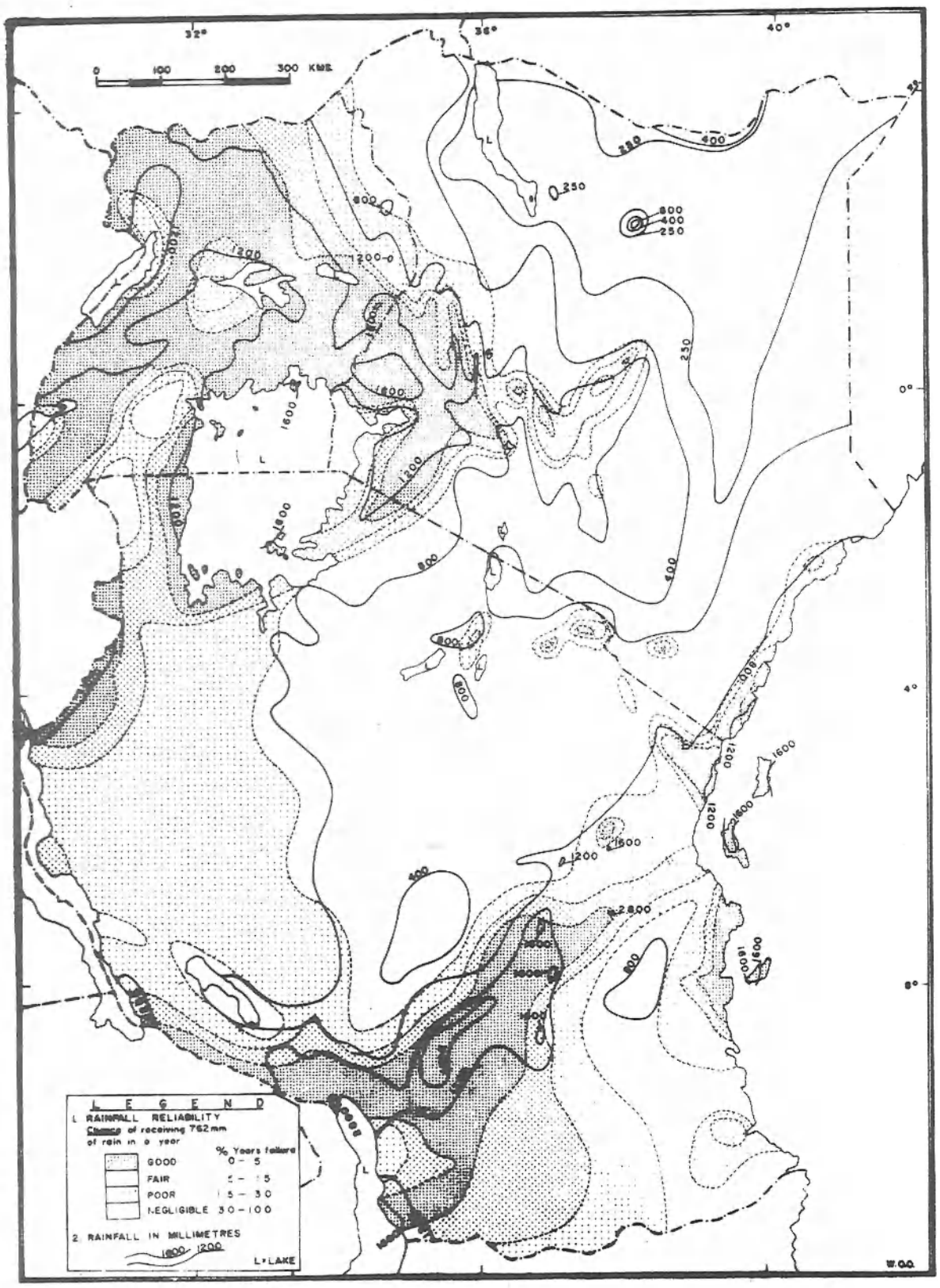


FIG. 8 APPROXIMATED EAST AFRICA SOIL FERTILITY POTENTIAL MAP


32°
36°
40°
0 100 200 300 KMS
L
L
L

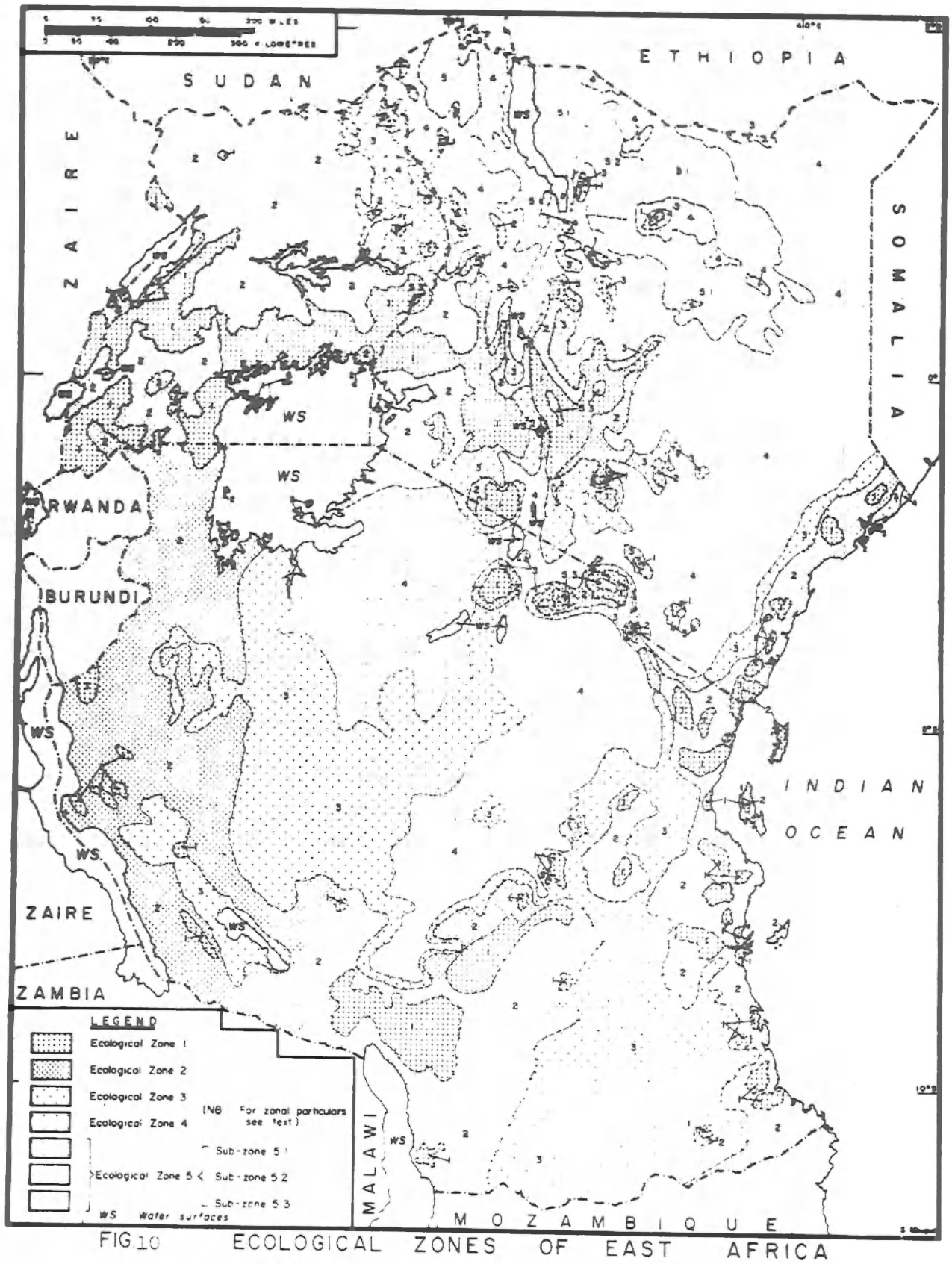


FIG 10 ECOLOGICAL ZONES OF EAST AFRICA

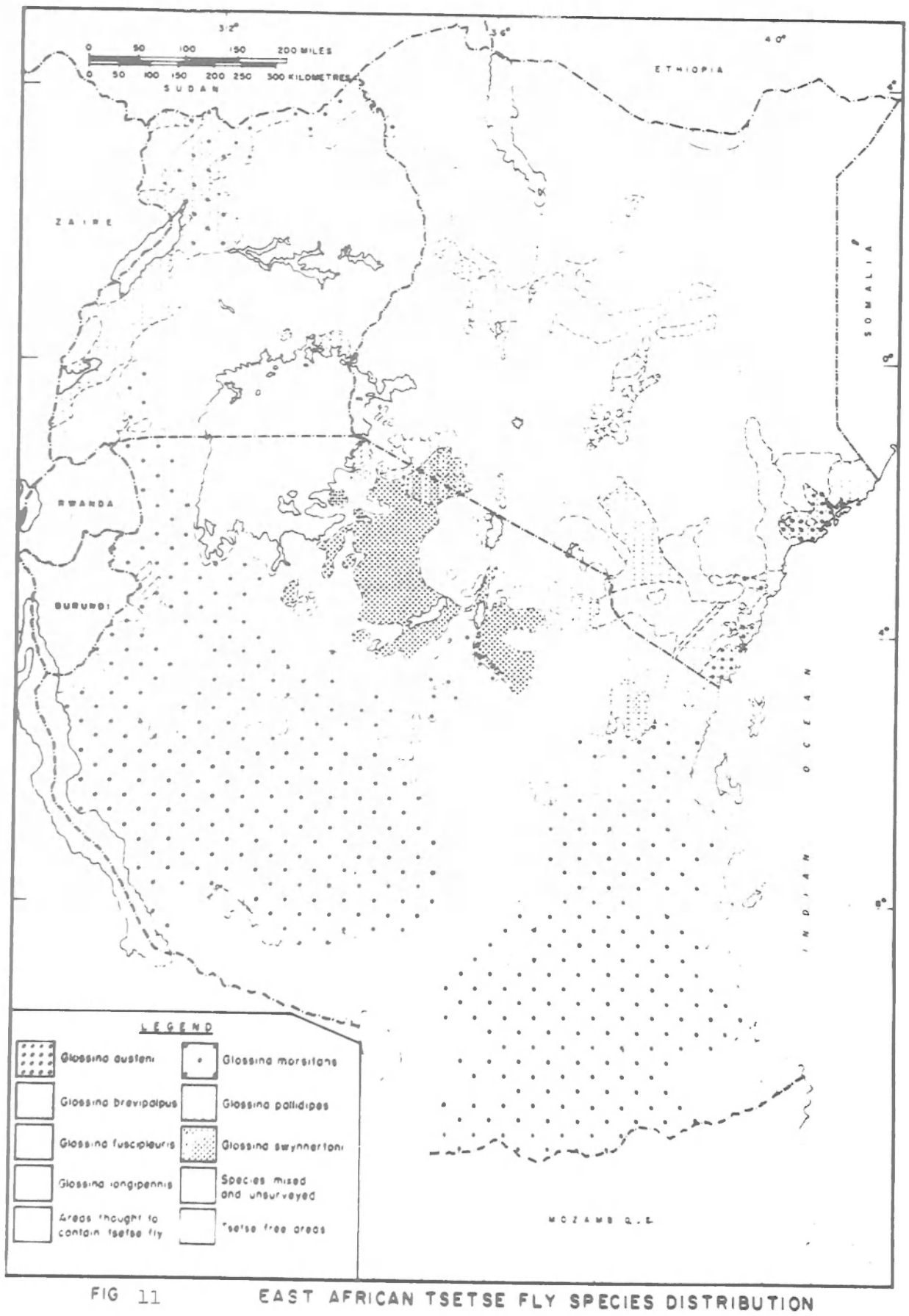


FIG 11 EAST AFRICAN TSETSE FLY SPECIES DISTRIBUTION

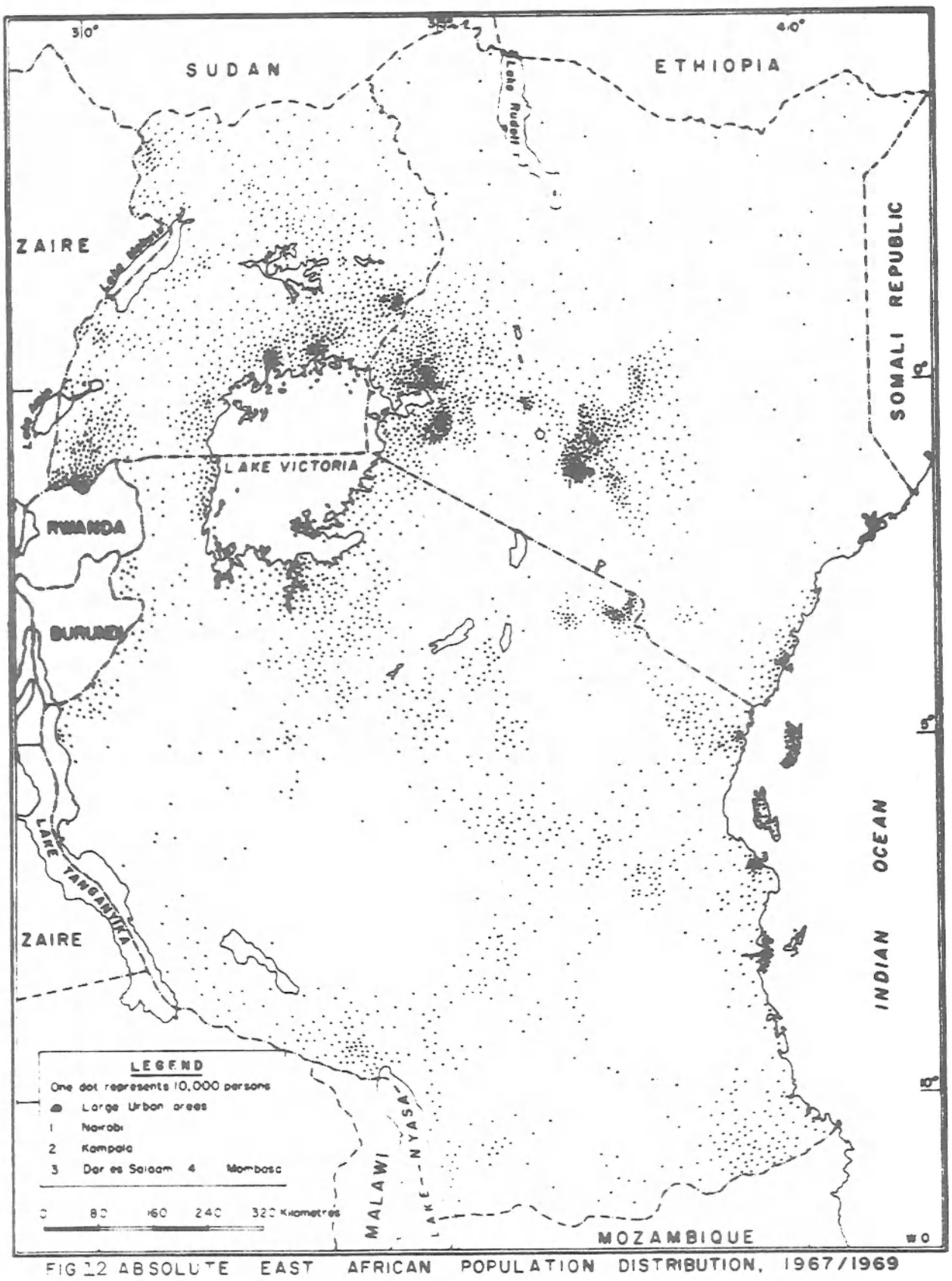


FIG 12 ABSOLUTE EAST AFRICAN POPULATION DISTRIBUTION, 1967/1969

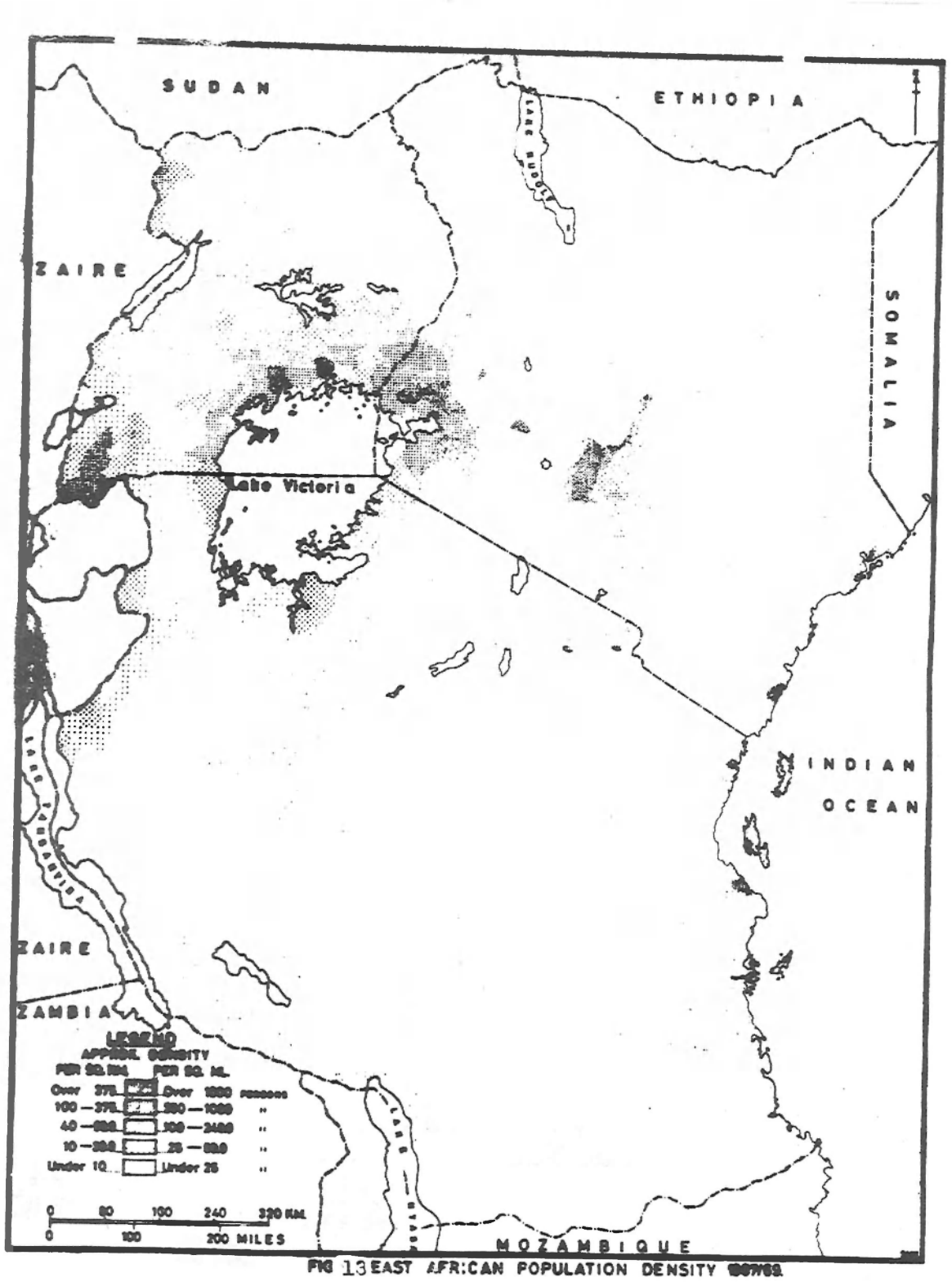


FIG 13 EAST AFRICAN POPULATION DENSITY 1967/68

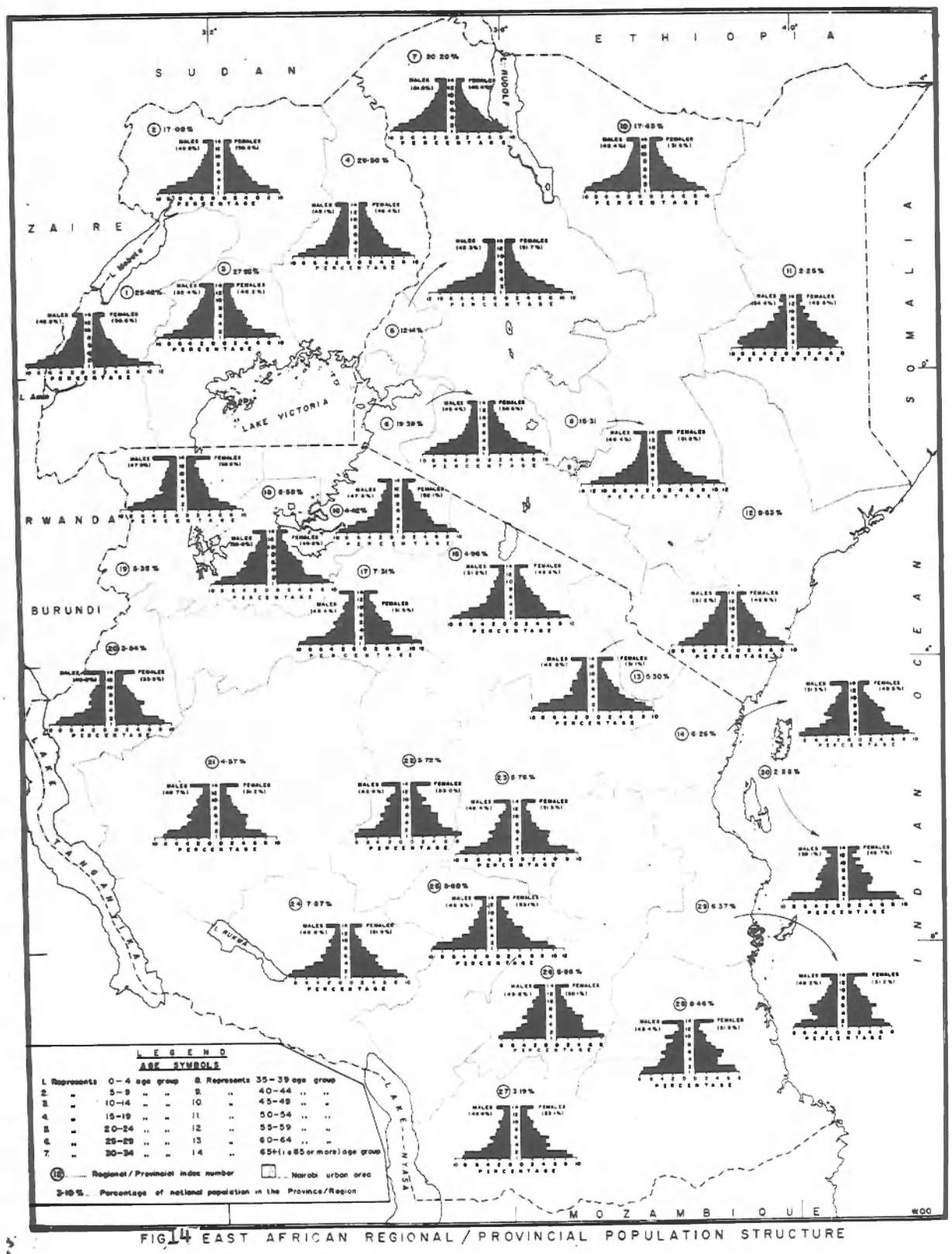


FIG 14 EAST AFRICAN REGIONAL / PROVINCIAL POPULATION STRUCTURE

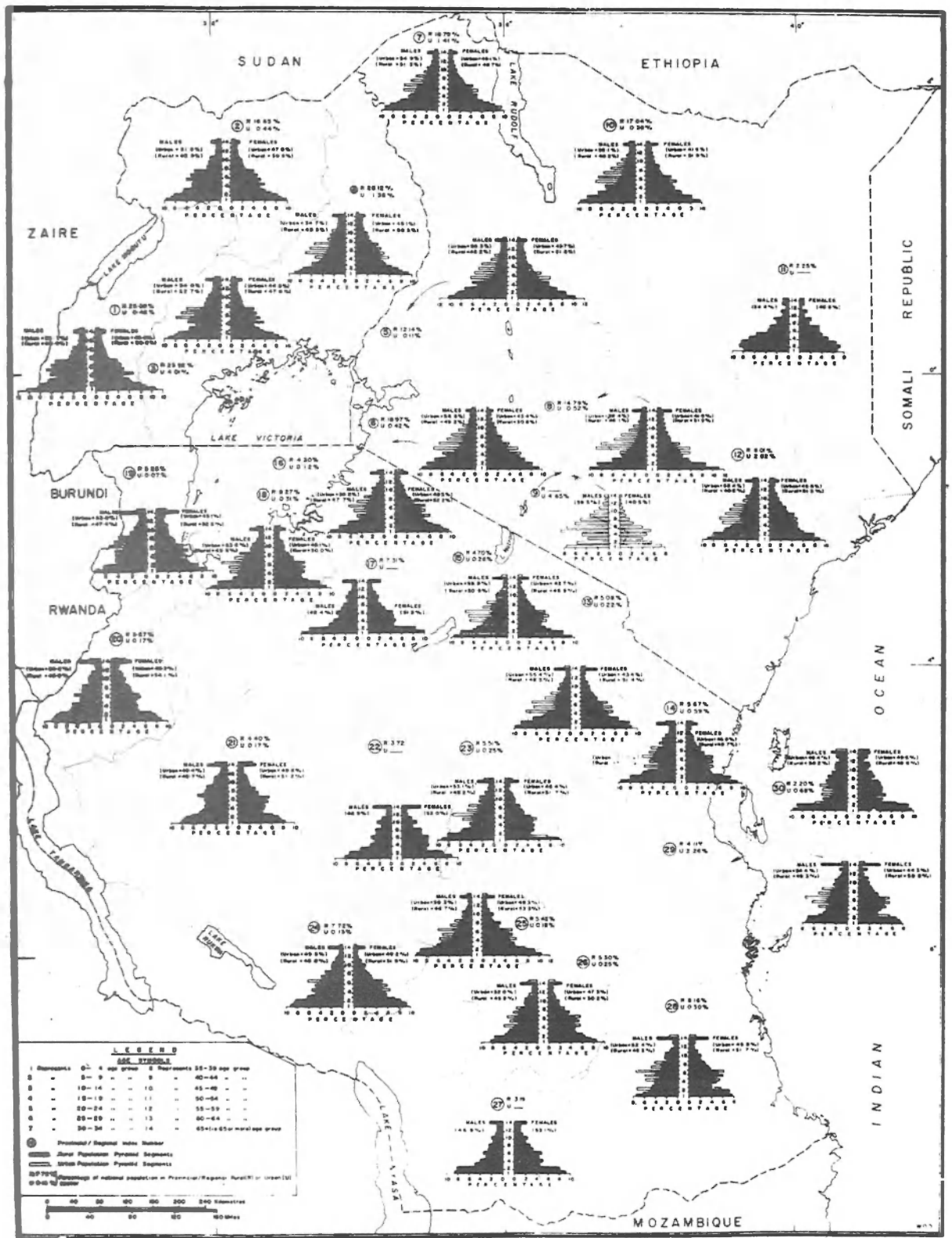


FIG15 E AFRICA: PROVINCIAL/REGIONAL COMPOSITE RURAL-URBAN POPULATION STRUCTURE

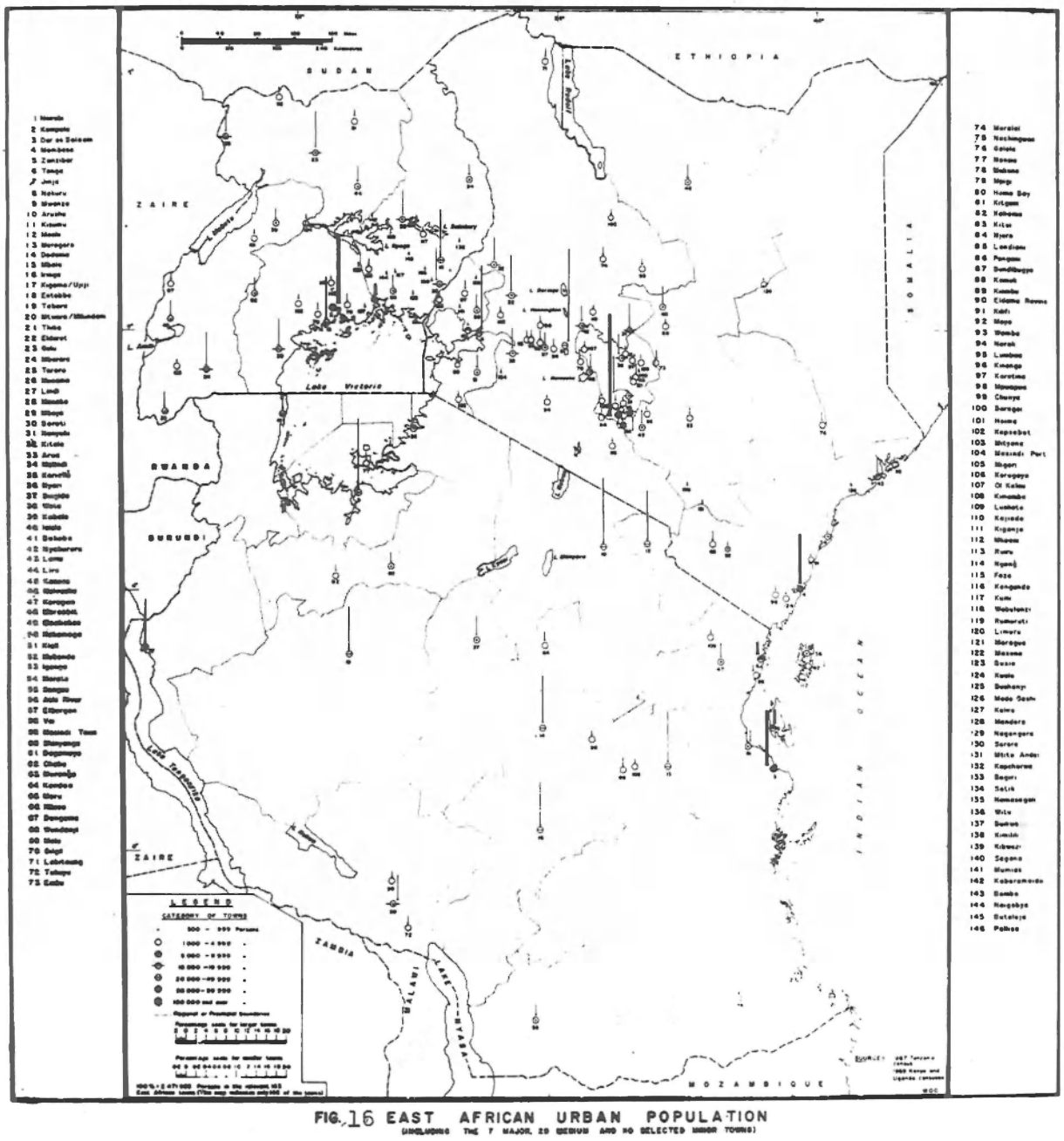


FIG. 16 EAST AFRICAN URBAN POPULATION
(INCLUDING THE 7 MAJOR, 20 MEDIUM AND 90 SELECTED MINOR TOWNS)

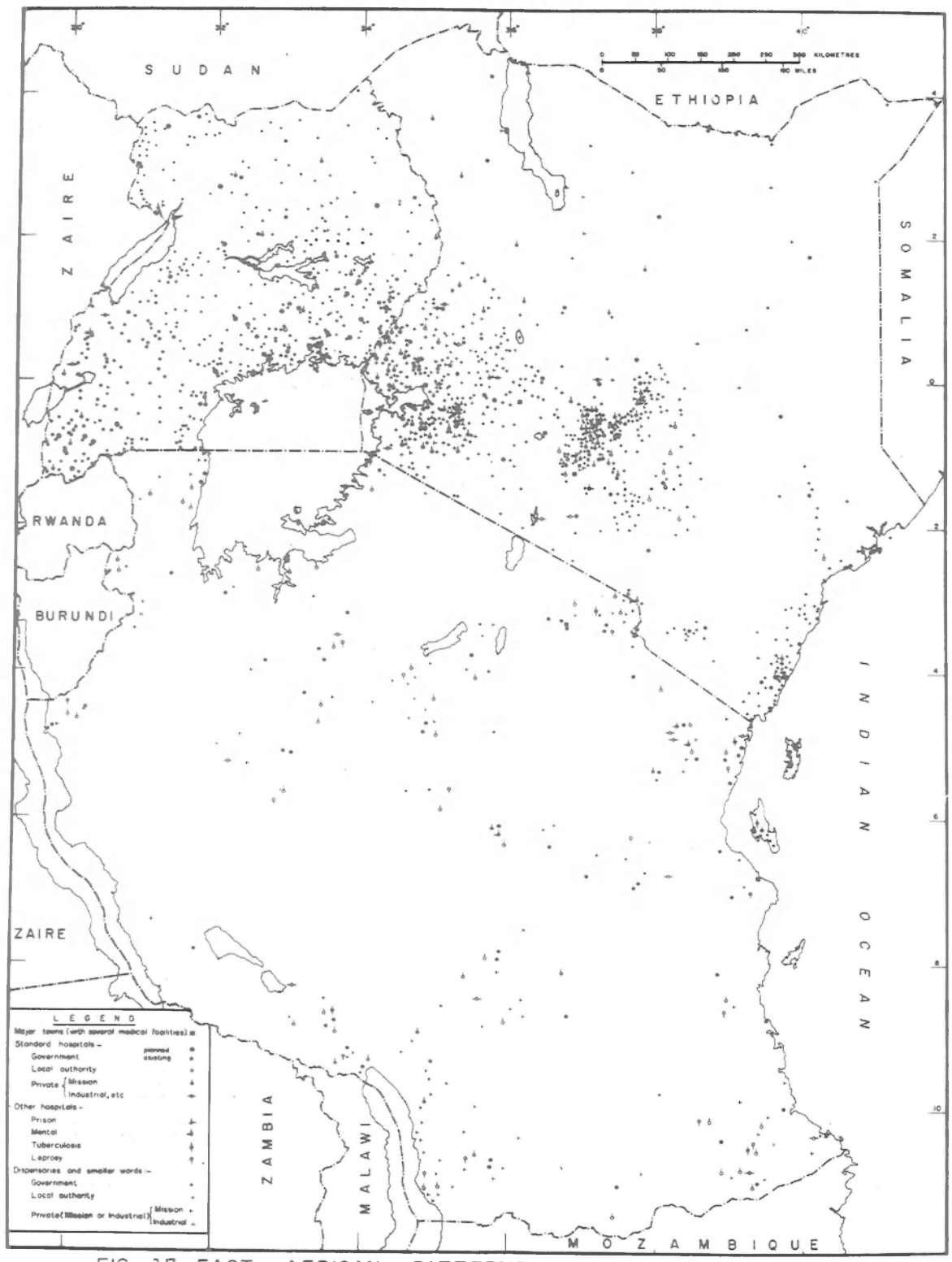


FIG. 17 EAST AFRICAN PATTERNS OF MEDICAL FACILITIES

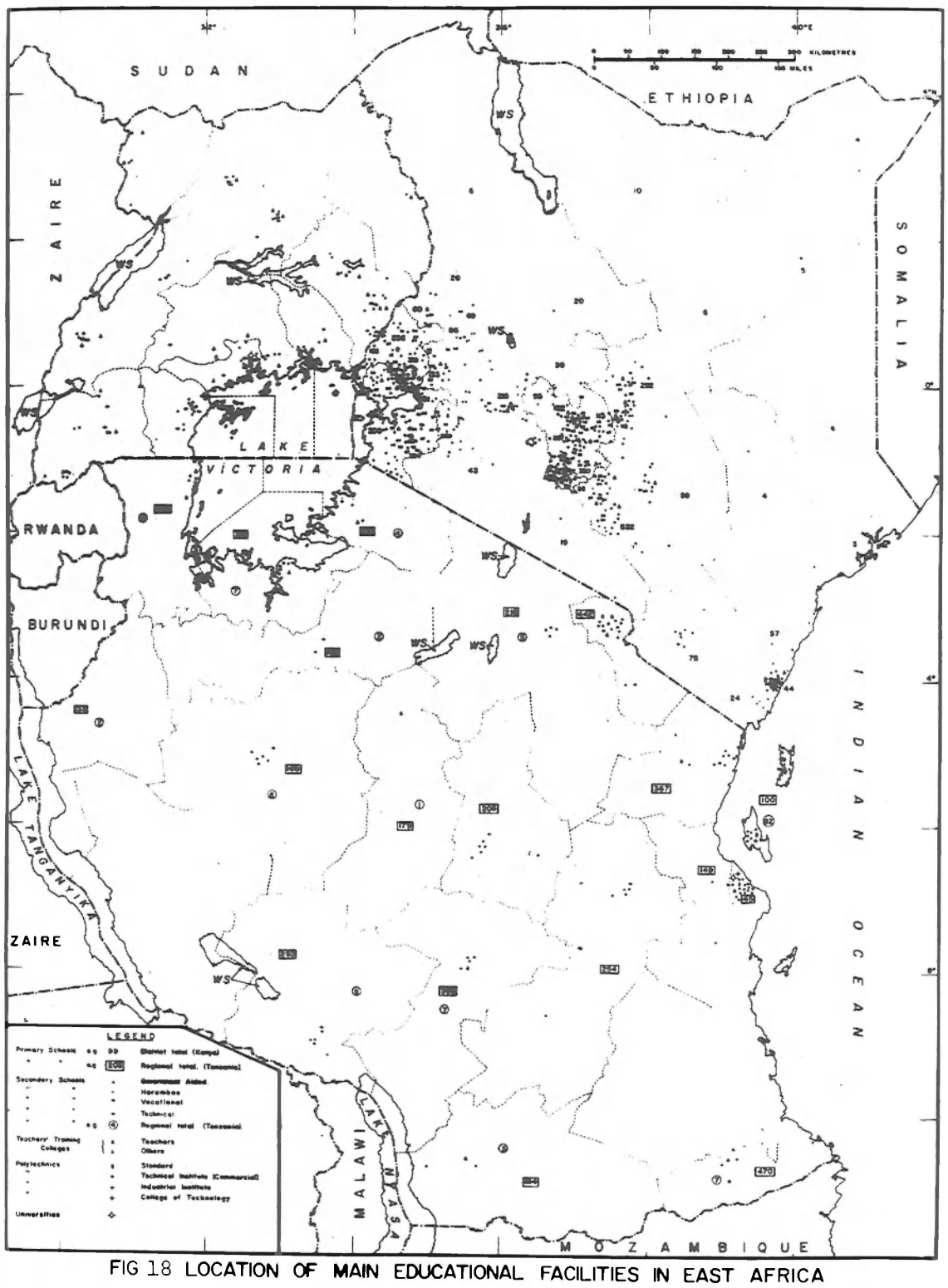


FIG 18 LOCATION OF MAIN EDUCATIONAL FACILITIES IN EAST AFRICA

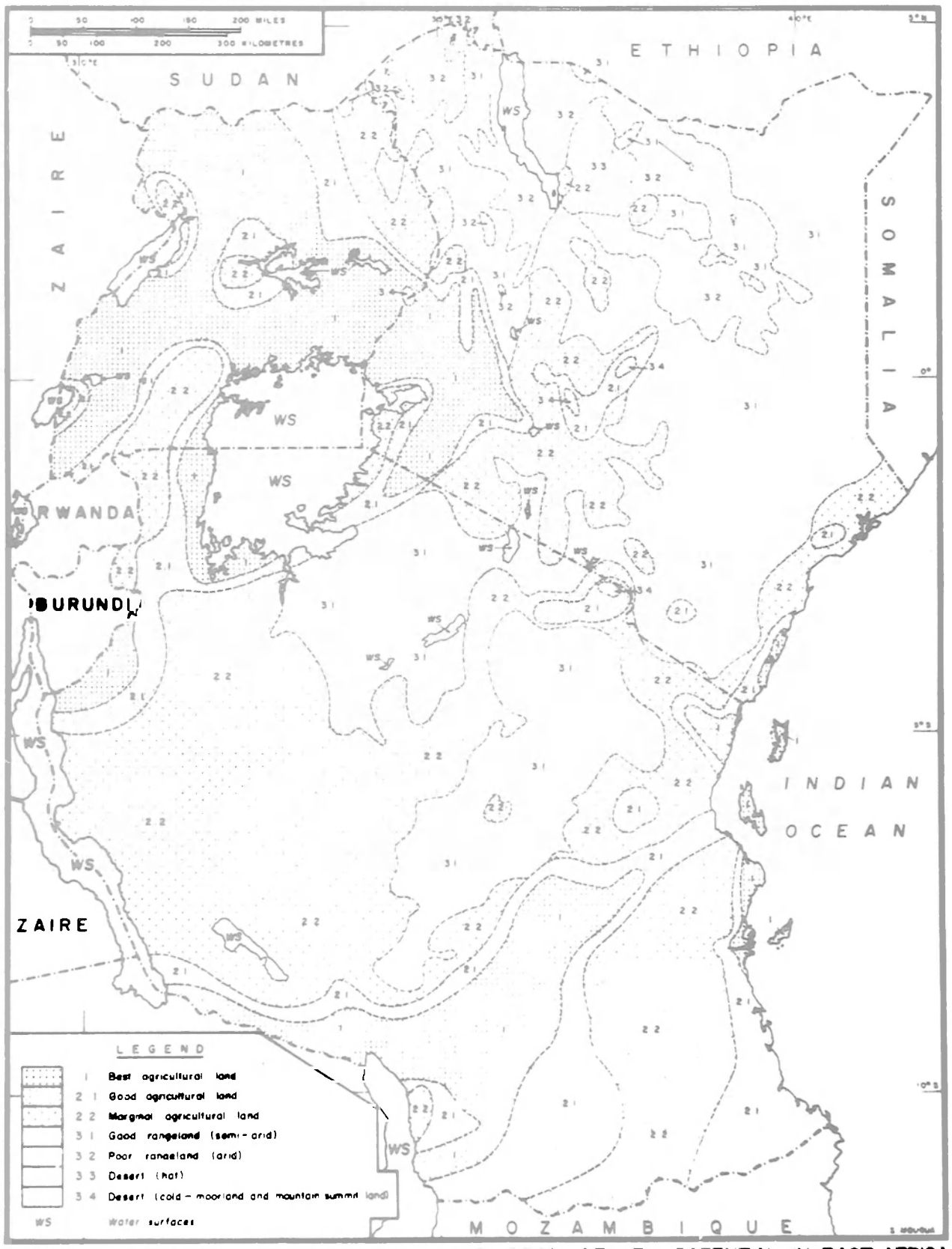
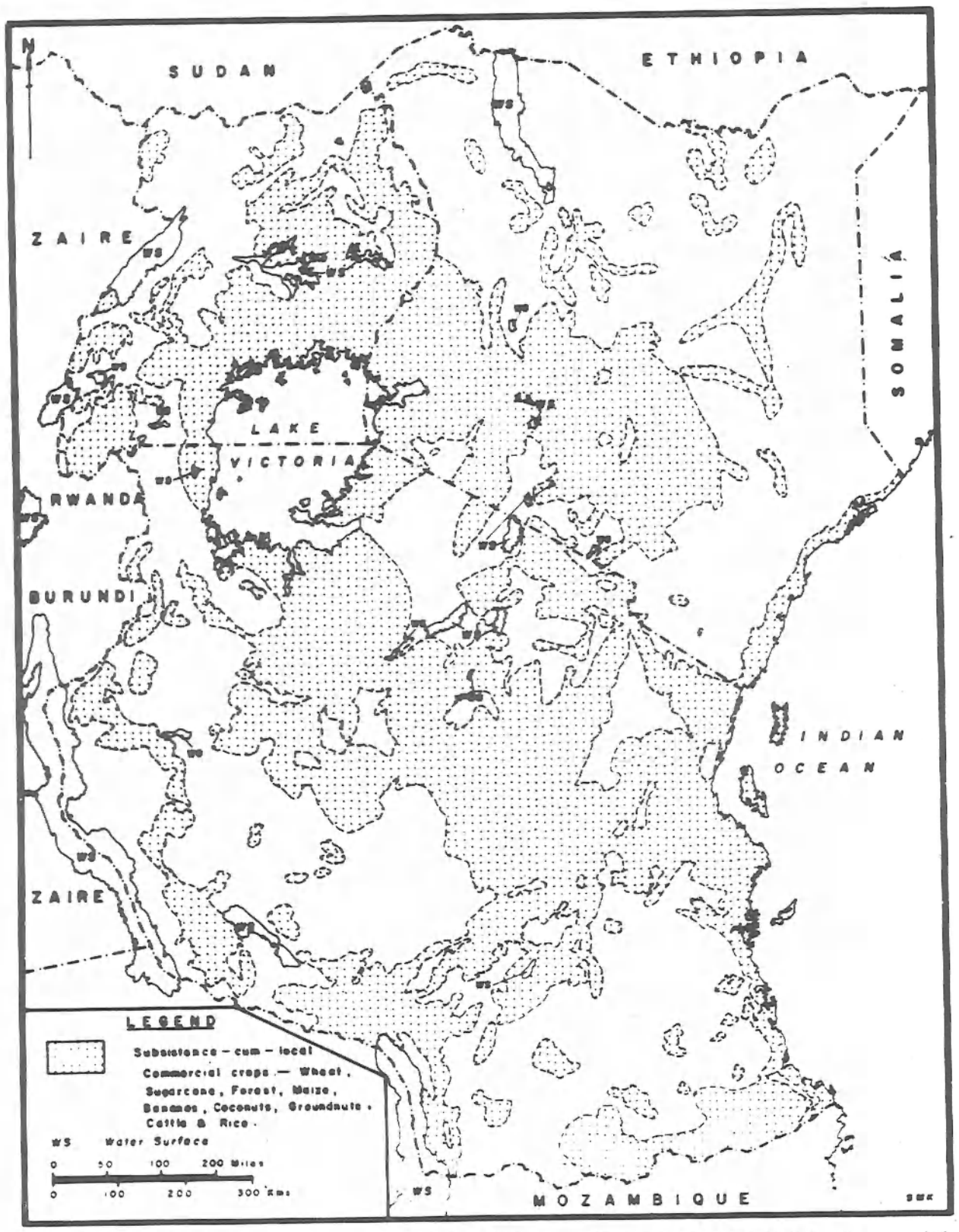
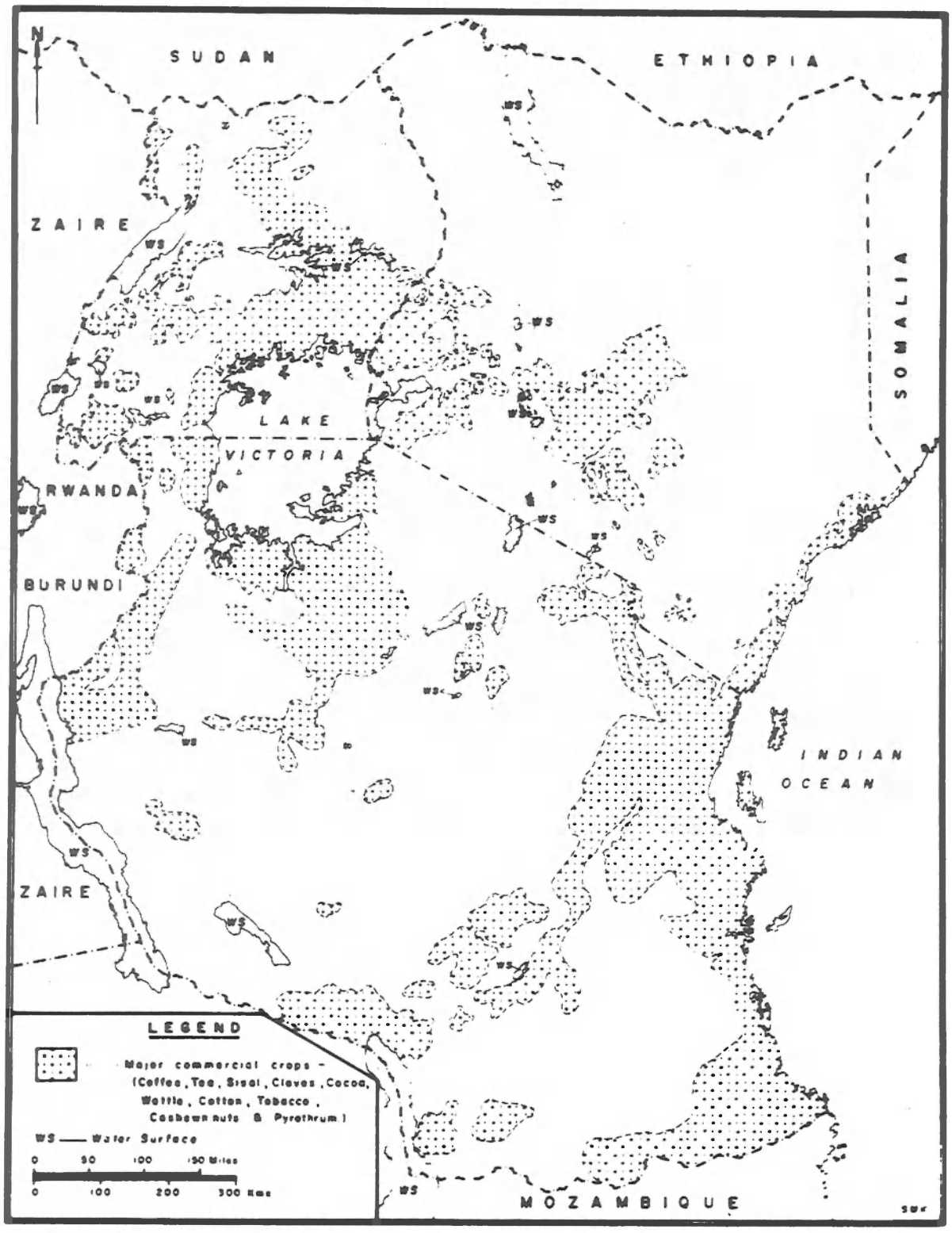


FIG 19 COMPOSITE AGRICULTURAL LAND PRODUCTIVITY POTENTIAL IN EAST AFRICA



Map 20 Composite pattern of East Afri n subsistence - cum - local commercial crops



Map 21 Composite pattern of major East African Commercial crops

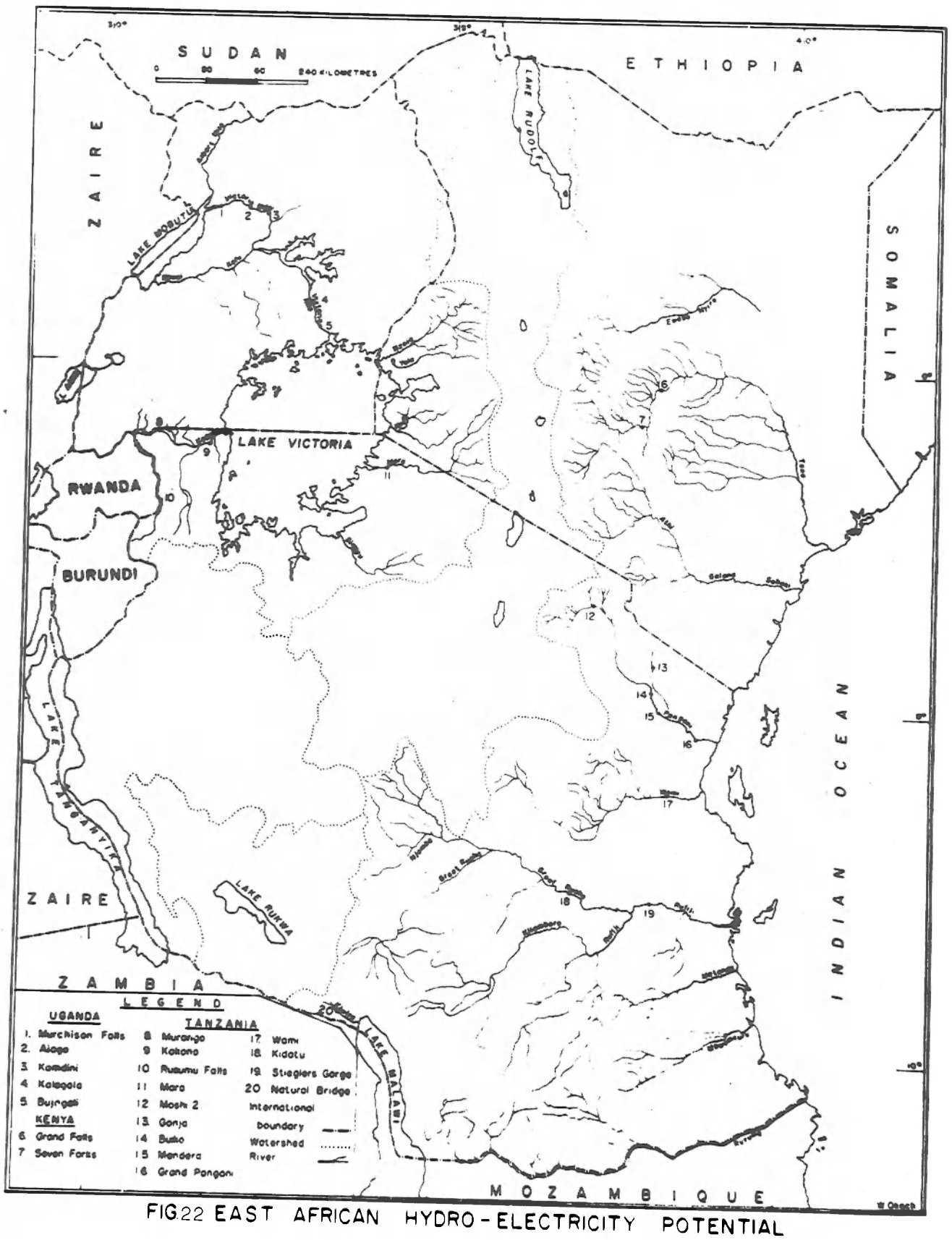


FIG.22 EAST AFRICAN HYDRO-ELECTRICITY POTENTIAL

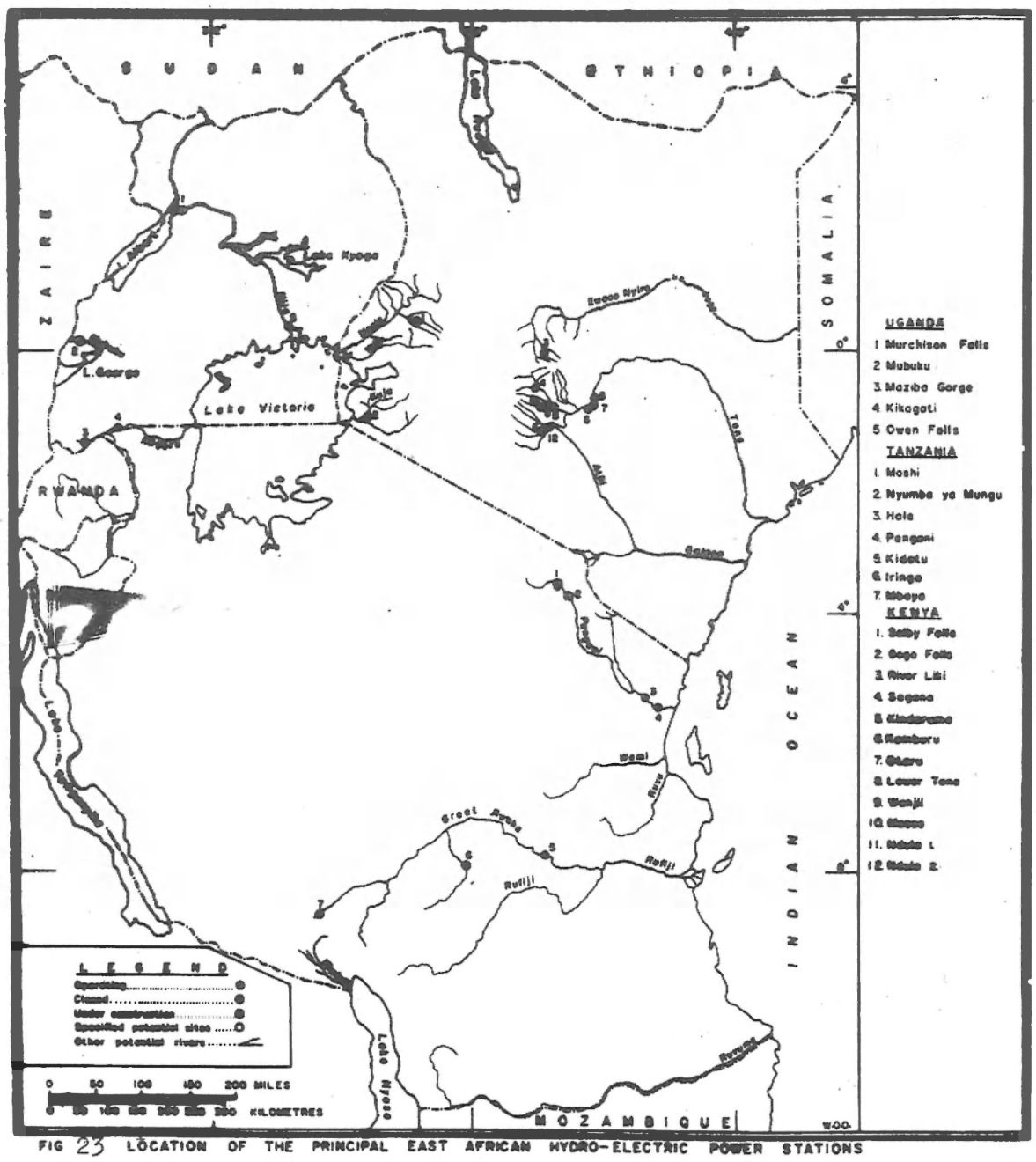


FIG 23 LOCATION OF THE PRINCIPAL EAST AFRICAN HYDRO-ELECTRIC POWER STATIONS

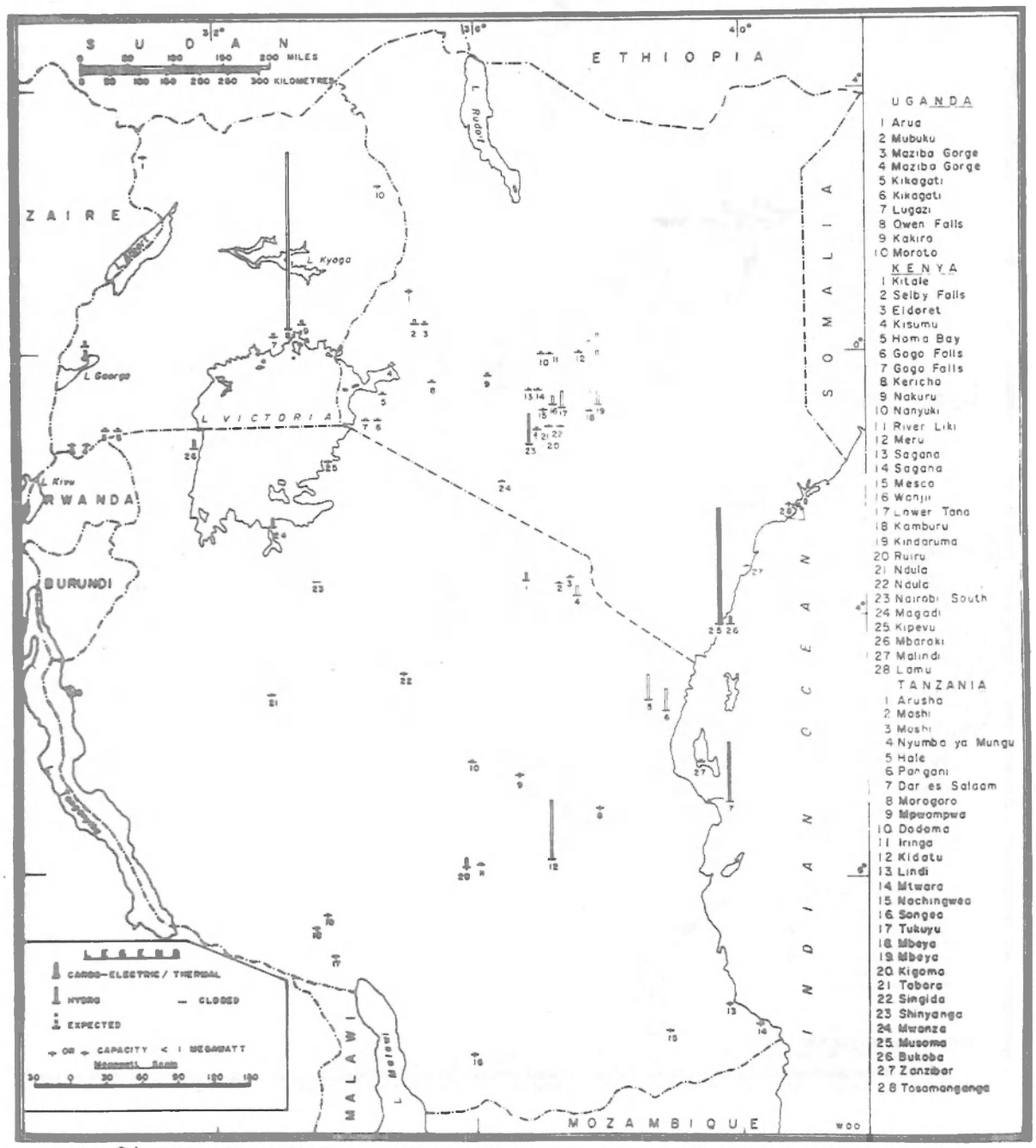


FIG 24 INSTALLED CAPACITY (IN MEGAWATTS) OF THE MAIN EAST AFRICAN POWER STATIONS

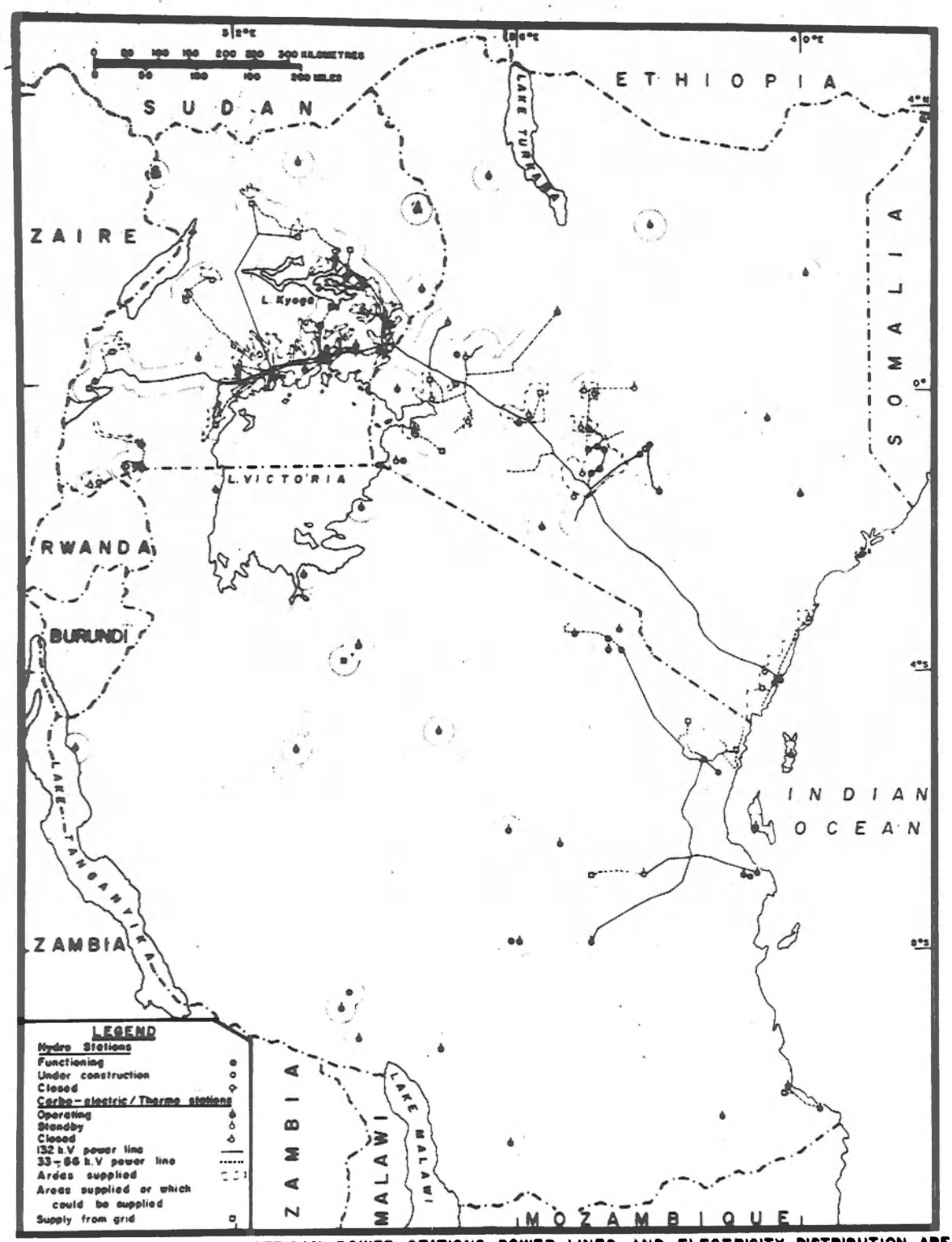


FIG 25 PATTERNS OF EAST AFRICAN POWER STATIONS, POWER LINES AND ELECTRICITY DISTRIBUTION AREAS

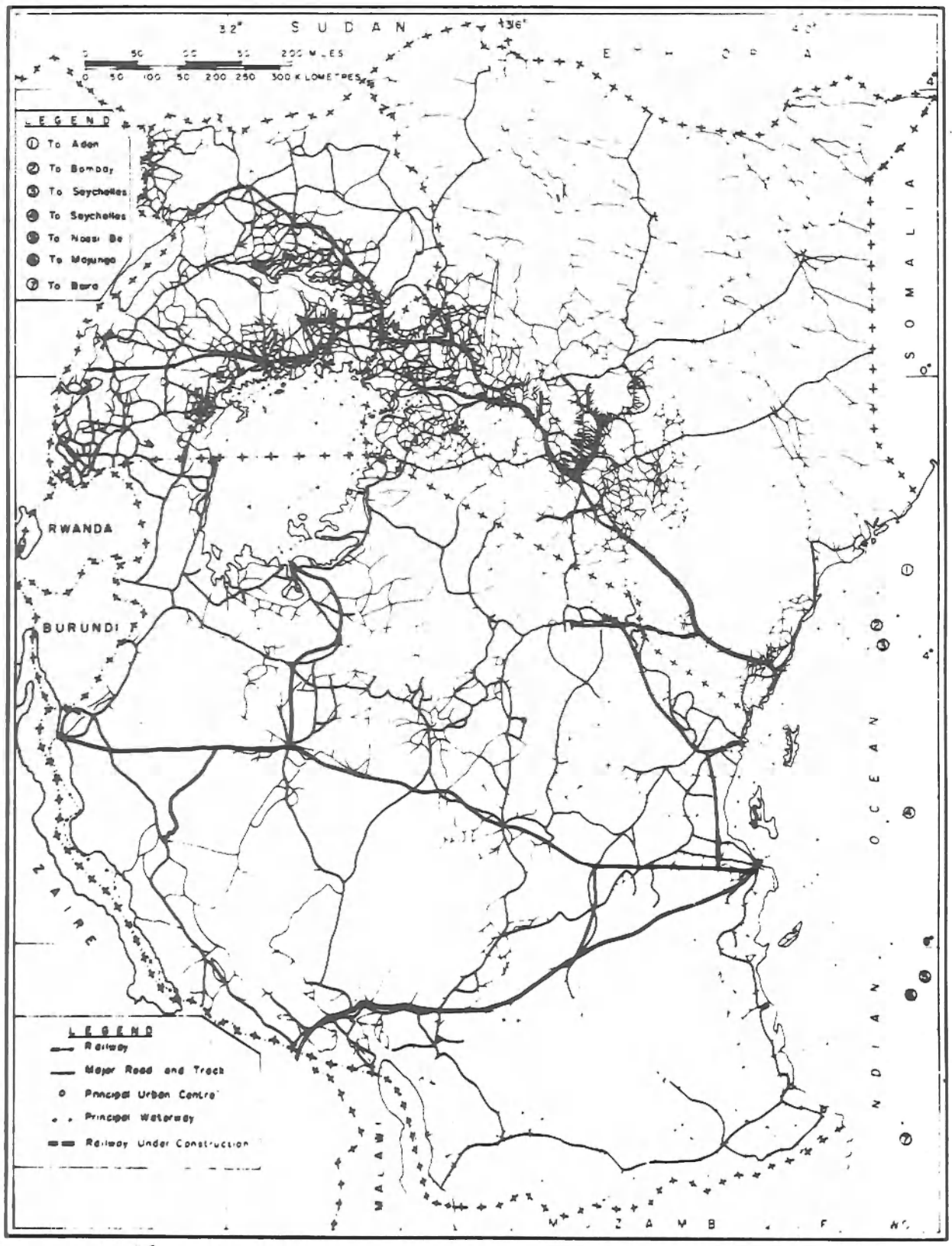


FIG 26 EAST AFRICAN RAILWAYS ROADS AND PRINCIPAL WATERWAYS

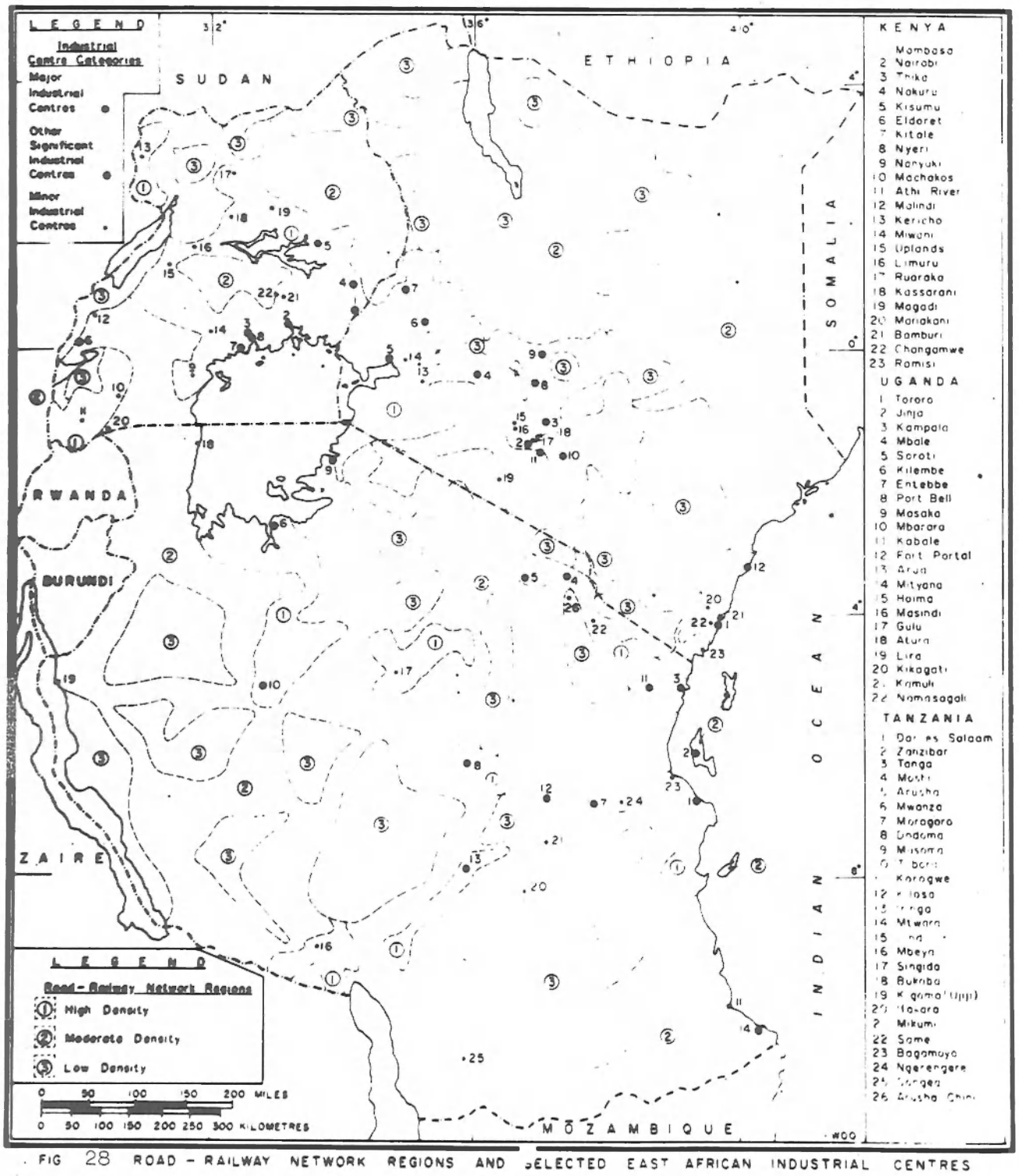


FIG 28 ROAD - RAILWAY NETWORK REGIONS AND SELECTED EAST AFRICAN INDUSTRIAL CENTRES

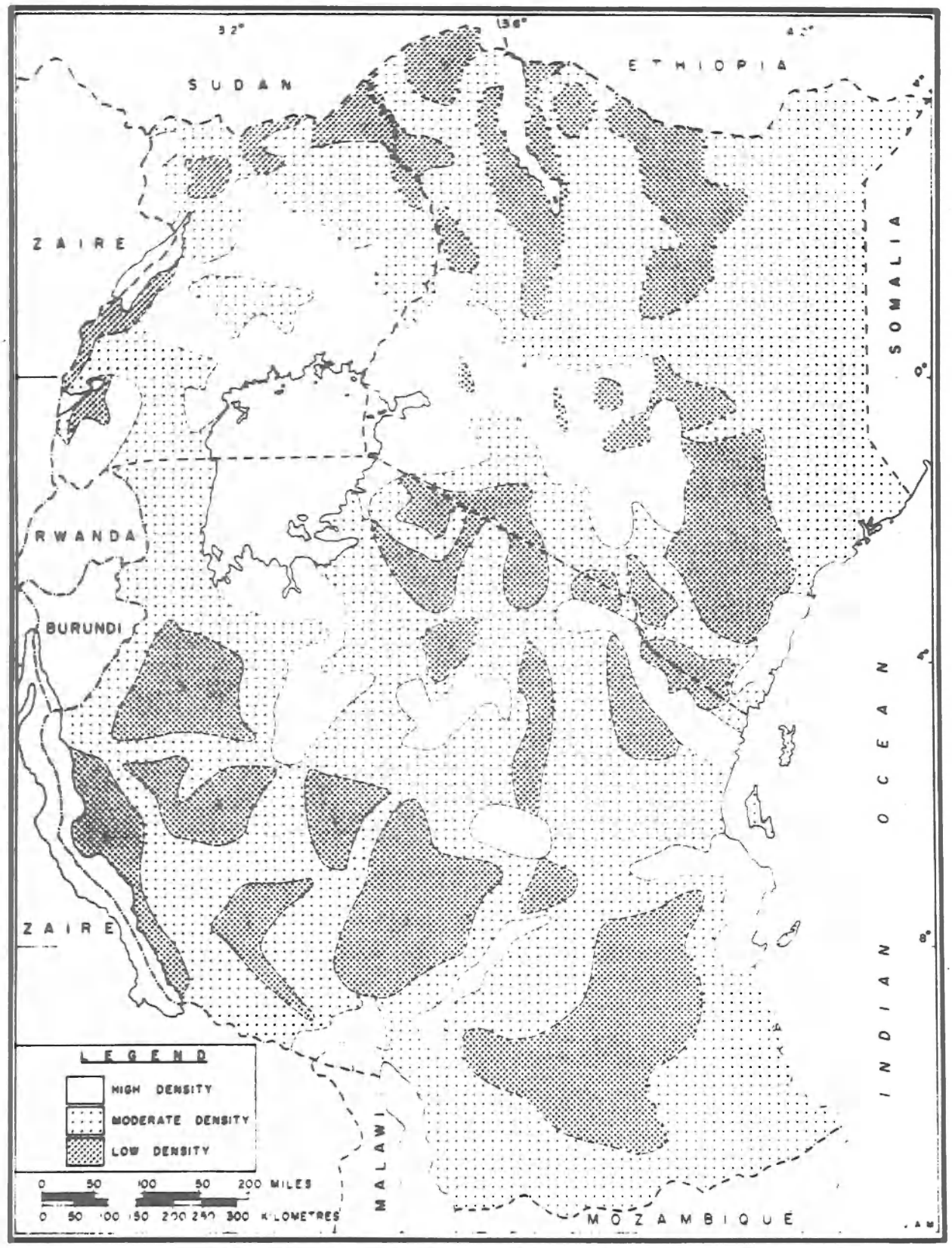


FIG 27 RAILWAY AND ROAD DENSITY REGIONS OF EAST AFRICA

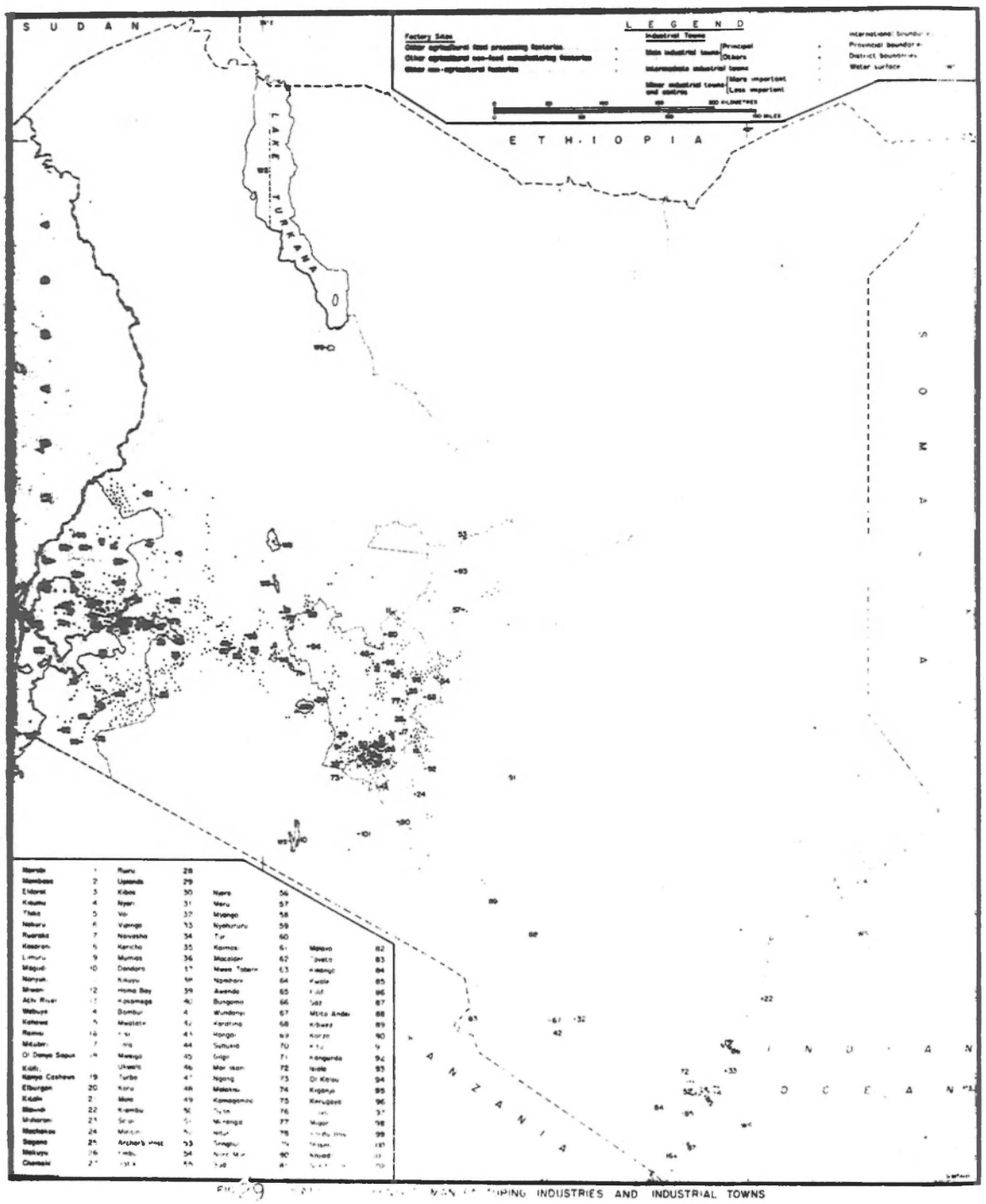


FIG. 9 MANUFACTURING INDUSTRIES AND INDUSTRIAL TOWNS

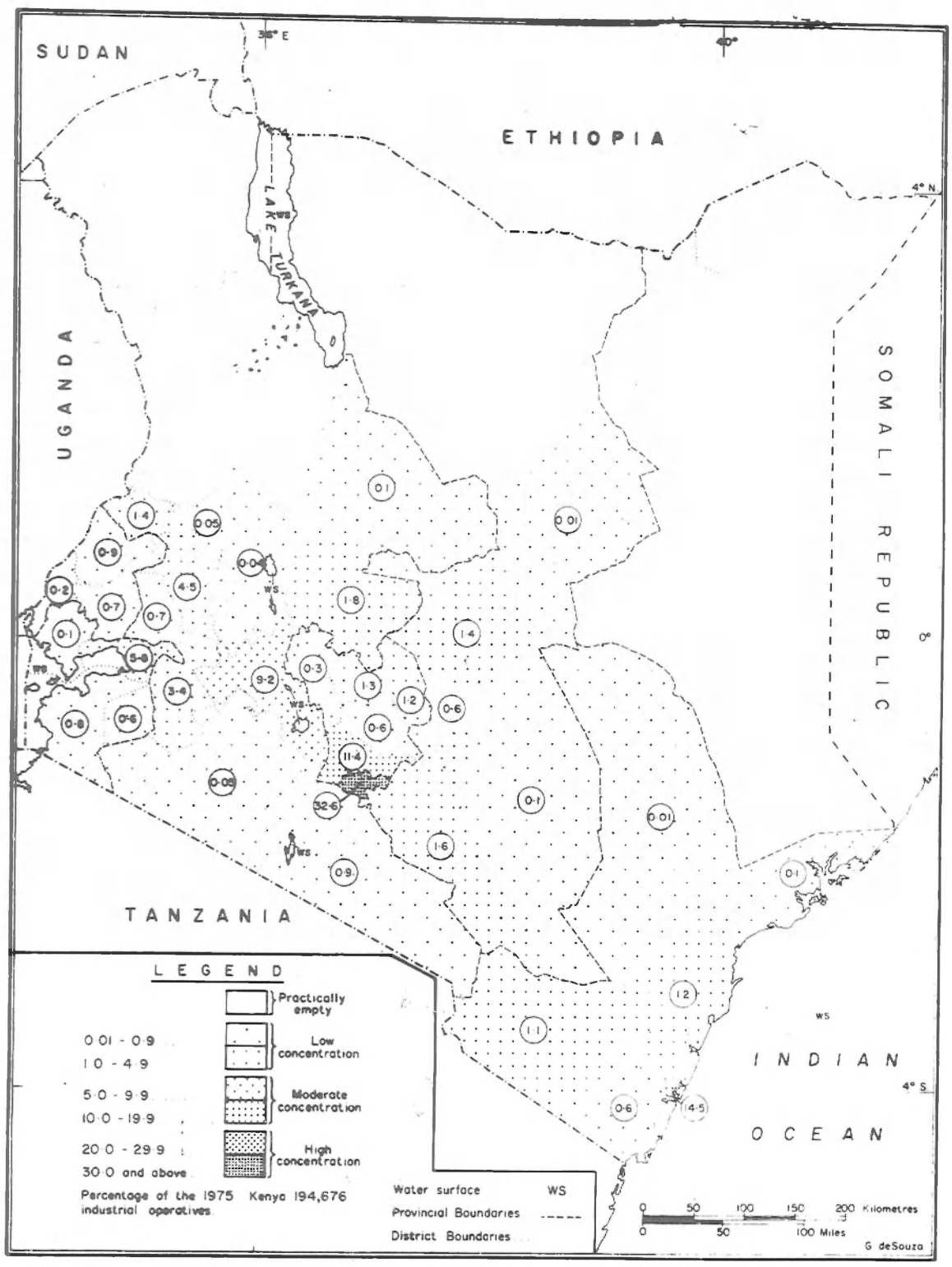


FIG. 30 LOCATION OF MANUFACTURING AND SERVICE INDUSTRIES IN KENYA

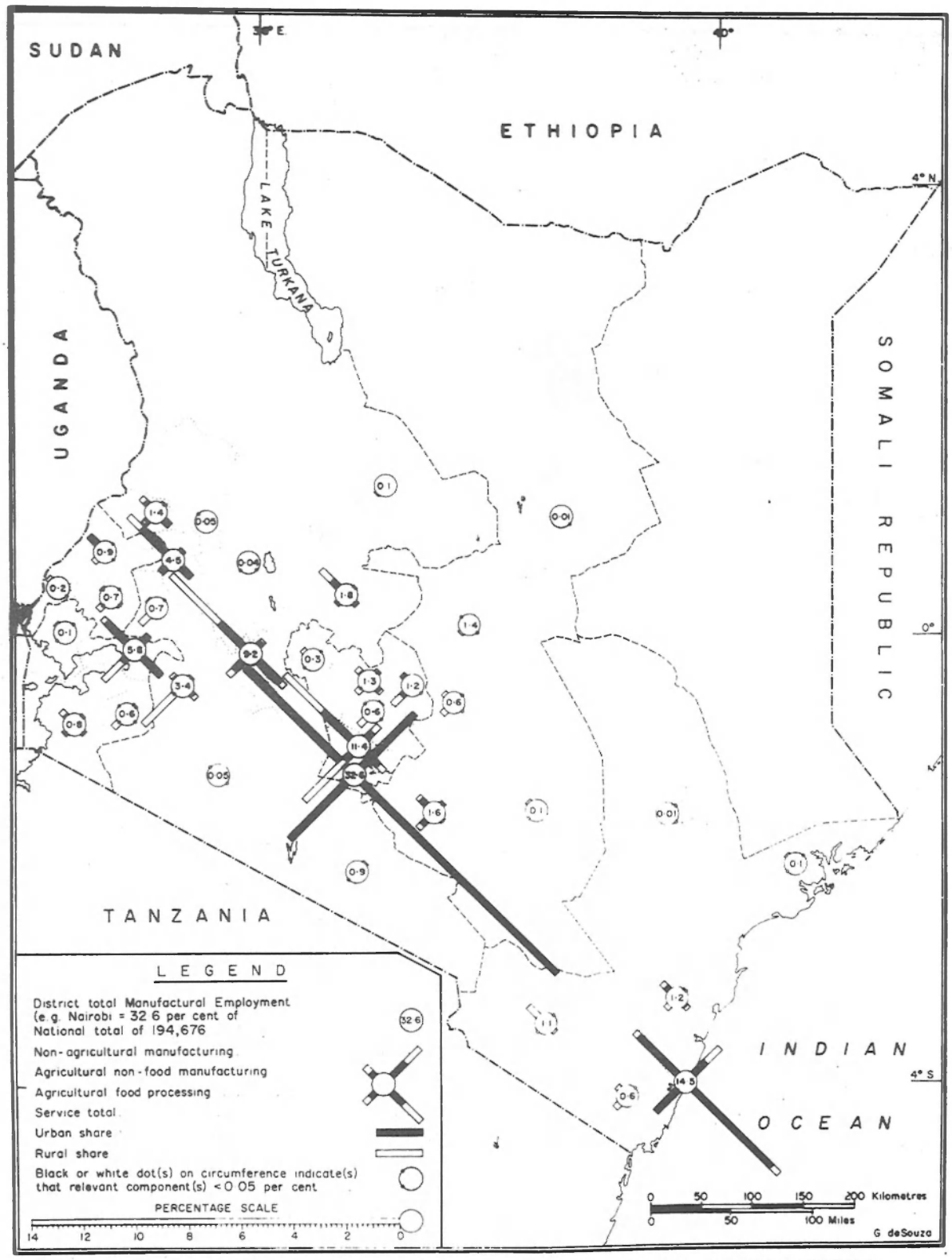


FIG. 31 STRUCTURAL DISTRIBUTION OF KENYA'S 194,676 MANUFACTURING AND SERVICE OPERATIVES IN 1975.

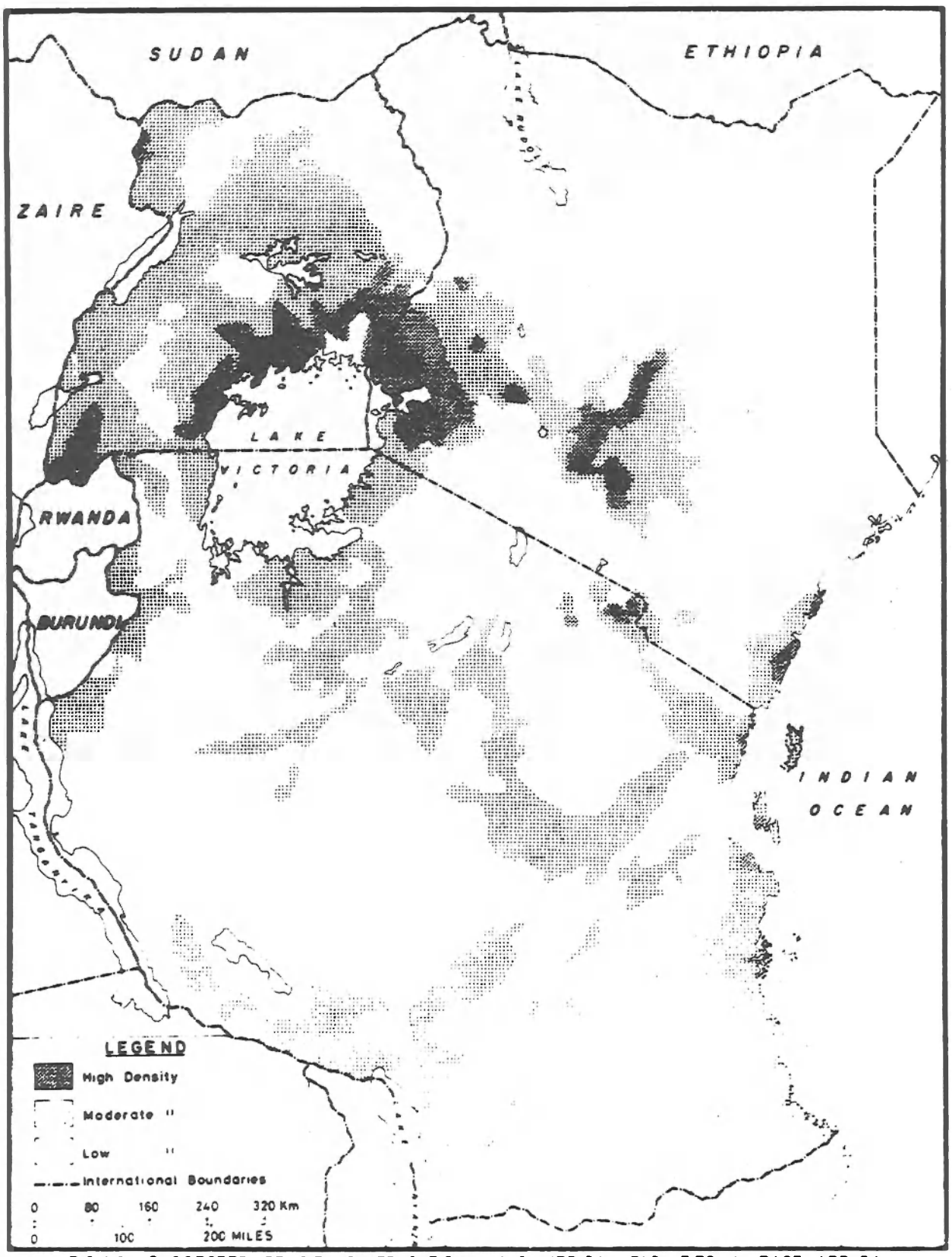


FIG 32 SUGGESTED DENSITY OF EDUCATIONAL AND MEDICAL FACILITIES IN EAST AFRICA

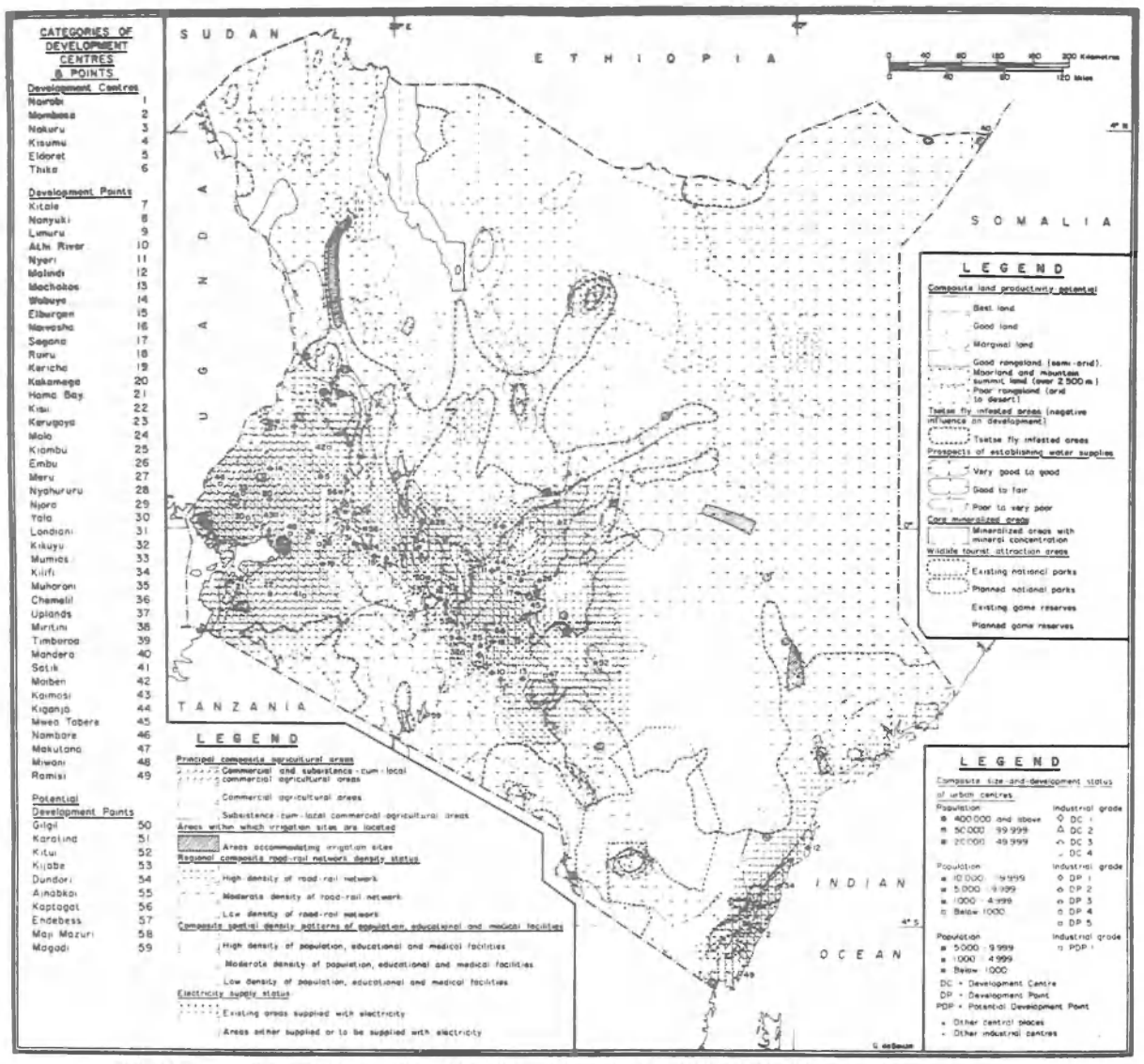


FIG. 33 . PATTERNS OF MAJOR FACTORS INFLUENCING ECONOMIC DEVELOPMENT PLANNING IN KENYA.

FISH SPECIES, DISTRIBUTION AND ABUNDANCE

By

N. Odero
Director of Fisheries
Ministry of Tourism and Wildlife
Kenya.

INTRODUCTION

Lake Victoria contains many types and species of fish some of which have only recently been introduced. These fish types include Tilapia, Bagrus, Barbus, Clarias, Mormyrus, Protopterus, Haplochromis, Labeo and Engraulicypris species and the Nile Perch, Lates niloticus. All the fish in the lake are edible, but the consumer preference is variable.

The Lake is fed by many fresh water rivers and streams, the major ones in Kenya being Sio, Nzoia, Yala, Nyando, Miriu and Kuja. The Lake is further fed by the flood waters of the torrential rains which are characteristic of the region. Pritchard (1966) states that the broad zone surrounding Lake Victoria although modified by altitude has equatorial climatic conditions and the rainfall is quite heavy, ranging between (45 and 80 inches) 1000 to 2000 mm. per year.

The flood waters often cause disasters by washing away homesteads and cultivated lands. On the other hand however, floods attract large numbers of anadromous and mud-dwelling fishes which are easily captured by the indigenous people, especially at the river mouths. Flood water fishing proved detrimental to the anadromous fish most of which were in the past caught in large quantities on their upstream spawning migration.

The fish stock abundance was in the past calculated from the catch returns obtained from the various fishermen operating around the Lake. In recent years these estimations have been made from bottom trawl surveys which have been conducted since 1968. However, records are still being maintained of the landings of various types and/or species of fish caught by the fishermen using different fishing methods. As early as 1960 Garrod had already indicated that from the available catch statistics then fishing activities showed increasing intensity which were leading to varying degrees of depletion of the inshore, more accessible fishing grounds.

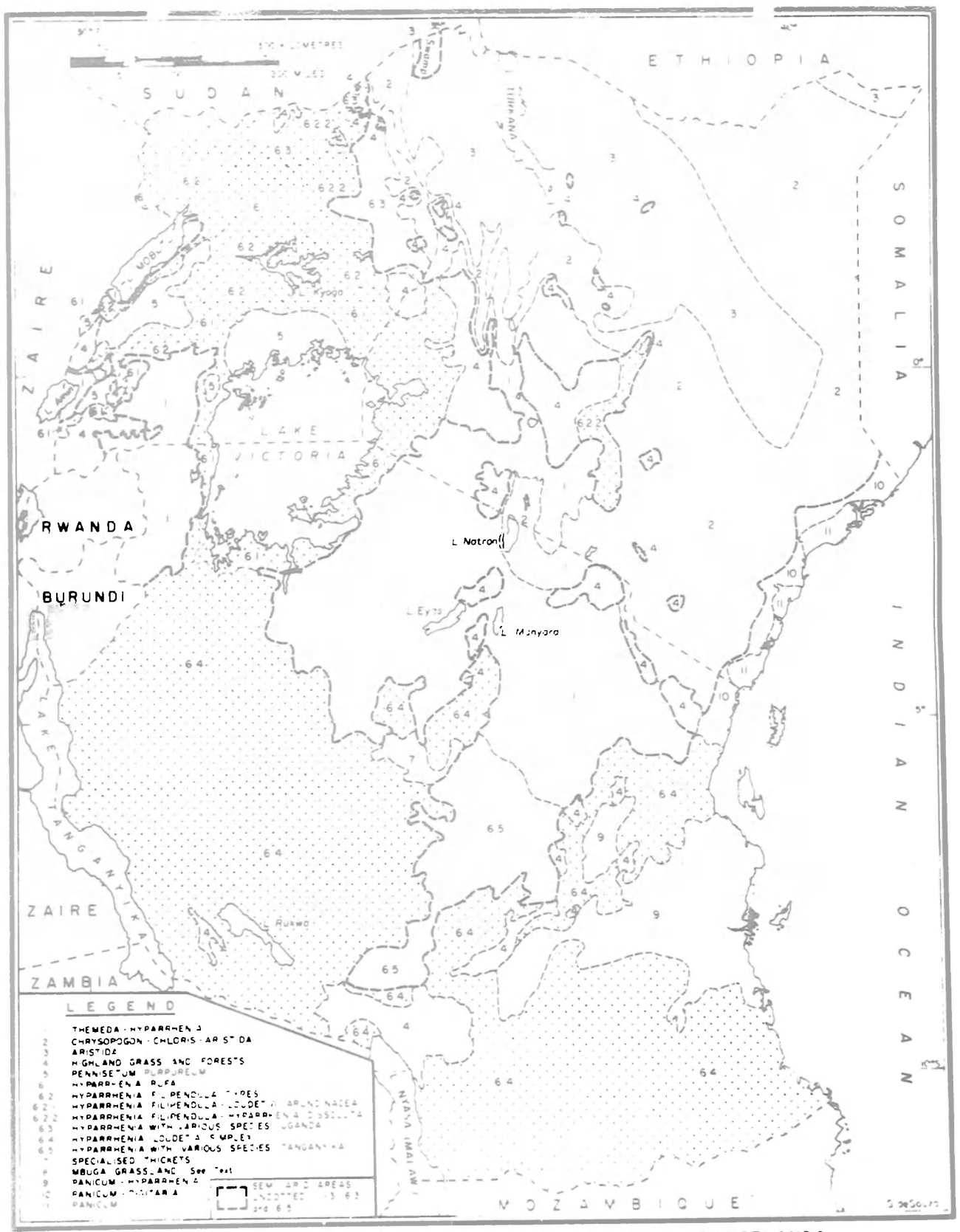


FIG. 5 EAST AFRICA: EXISTING AND POTENTIAL RANGELANDS

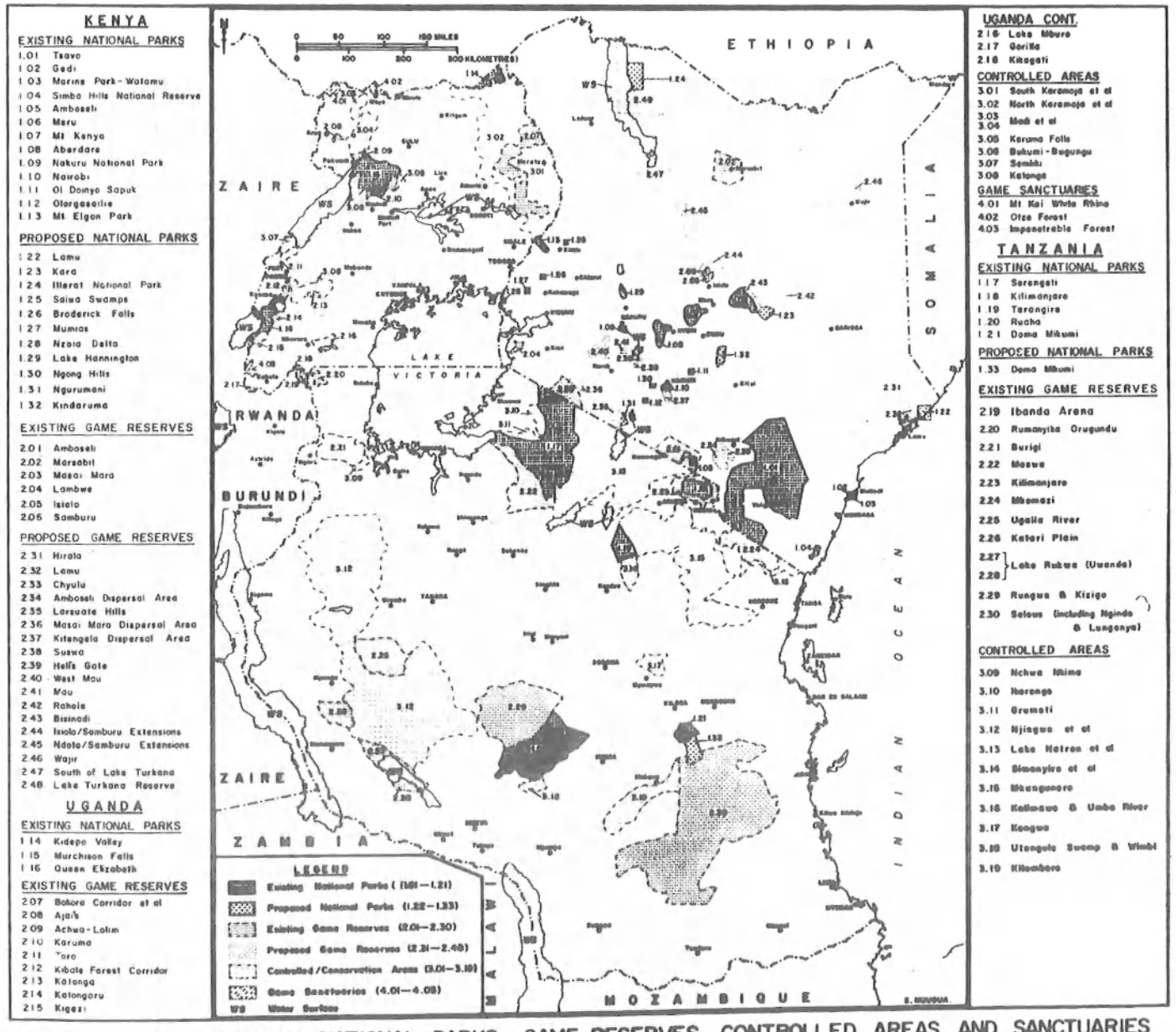


FIG. 6 EAST AFRICAN NATIONAL PARKS, GAME RESERVES, CONTROLLED AREAS AND SANCTUARIES

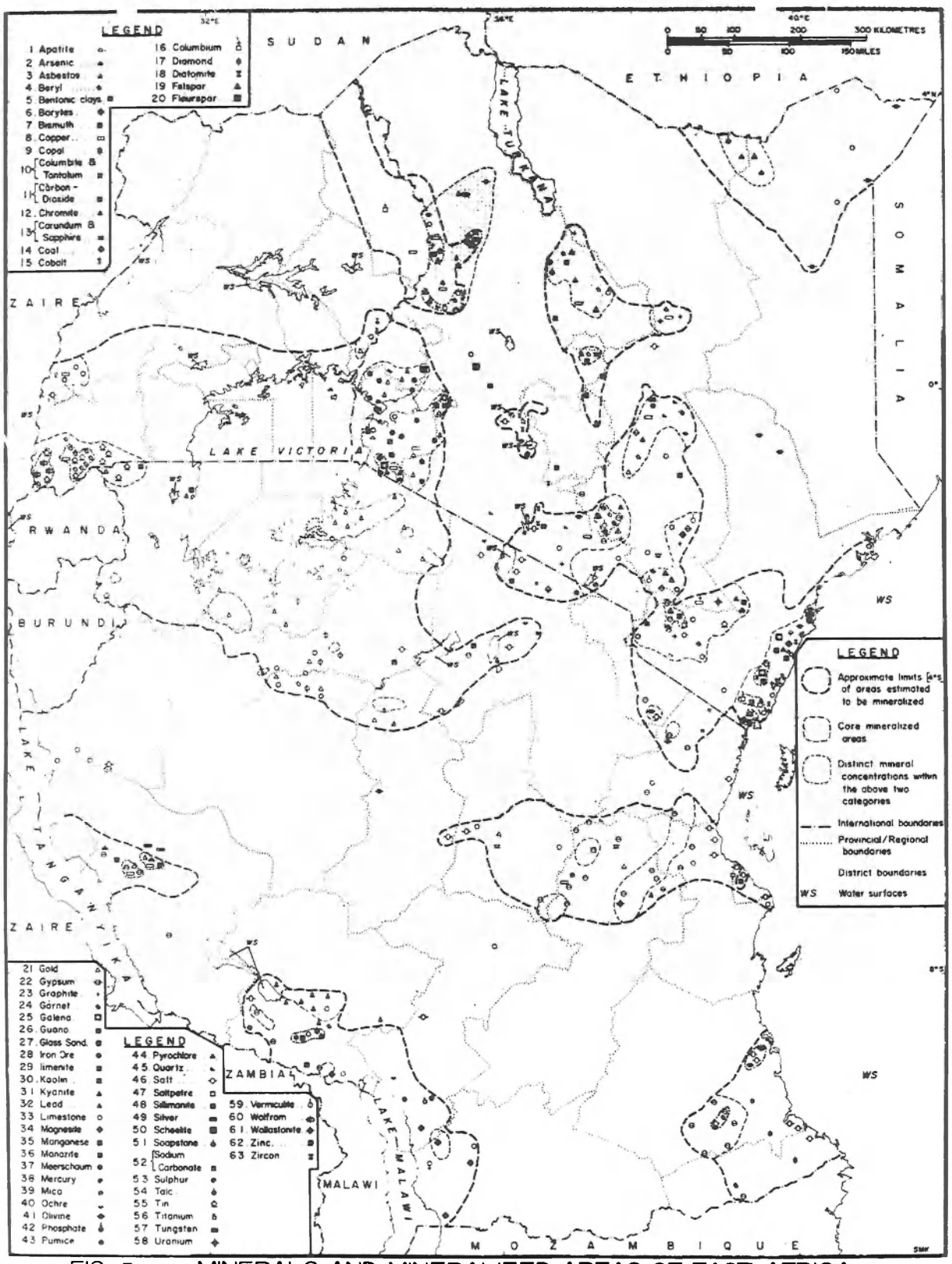


FIG 7 MINERALS AND MINERALIZED AREAS OF EAST AFRICA

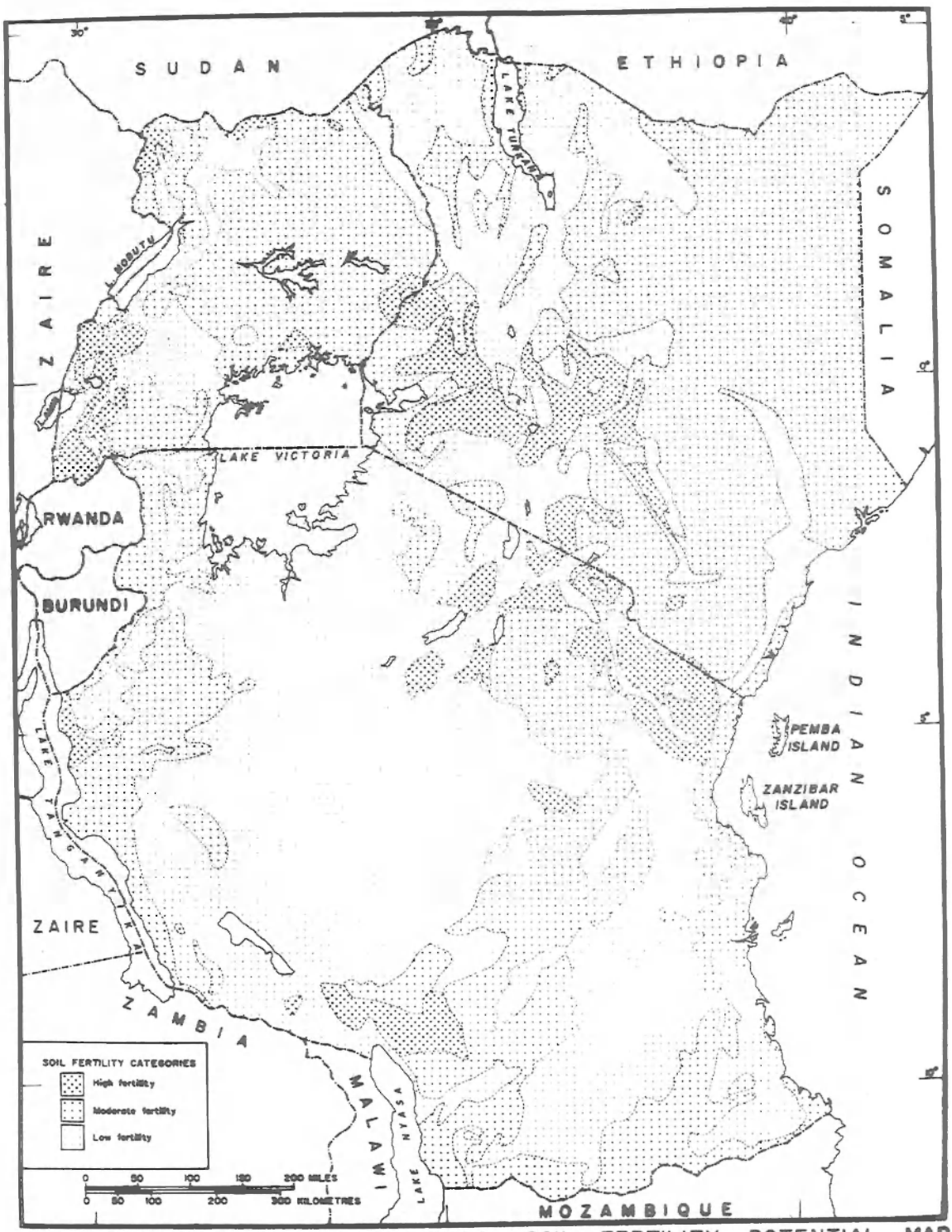
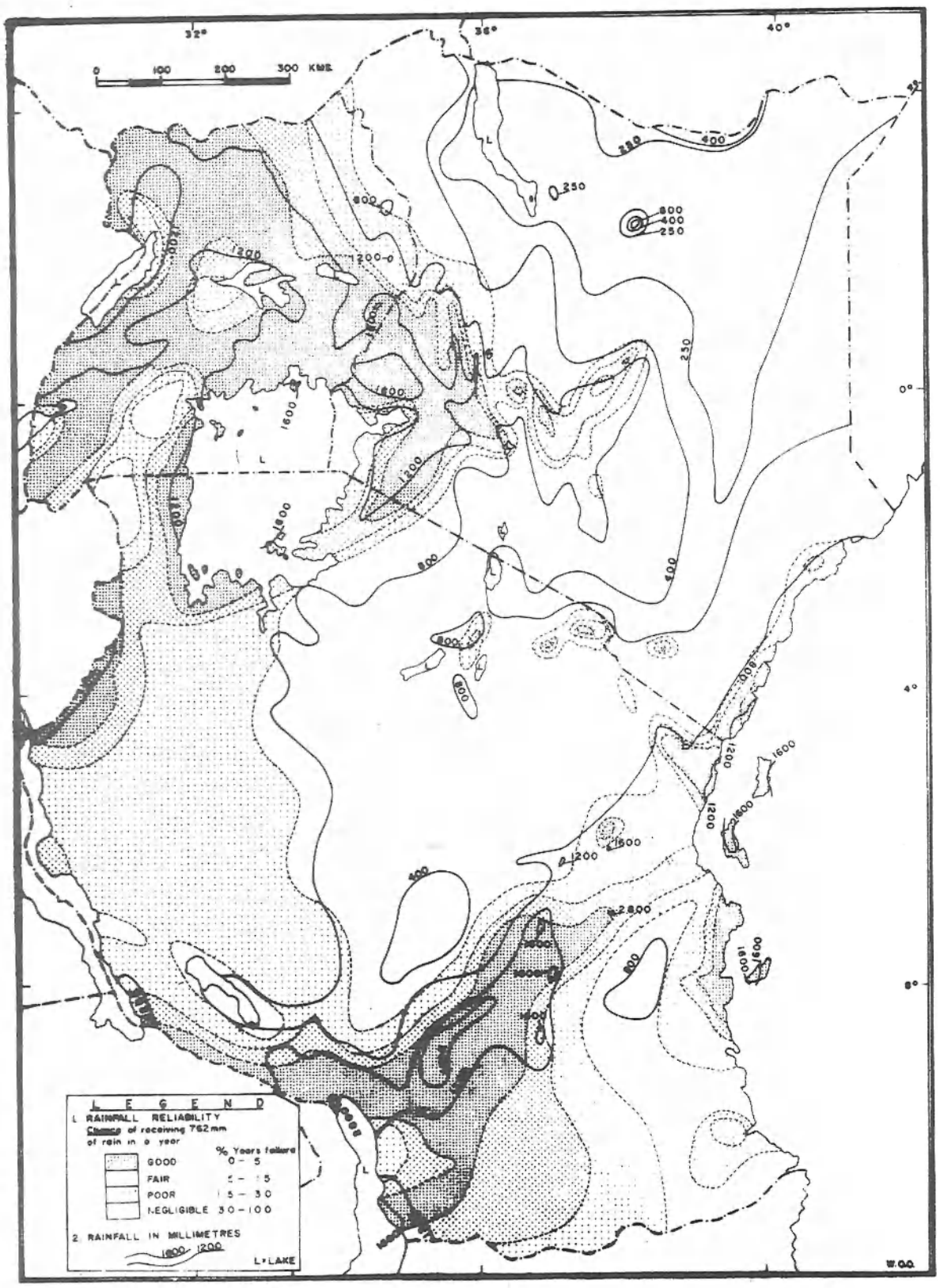


FIG. 8 APPROXIMATED EAST AFRICA SOIL FERTILITY POTENTIAL MAP


32°
36°
40°
0 100 200 300 KMS
L
L
L

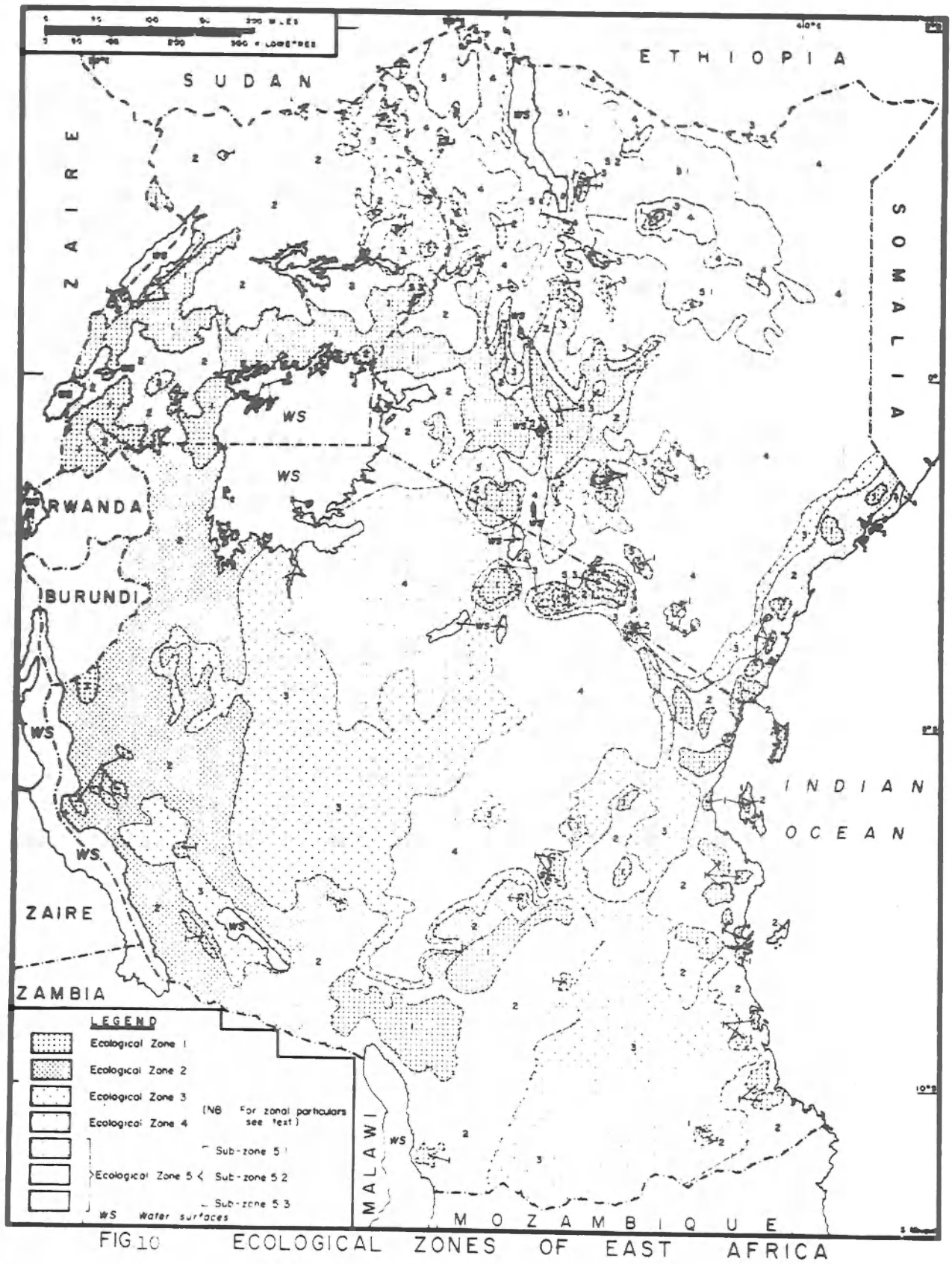


FIG 10 ECOLOGICAL ZONES OF EAST AFRICA

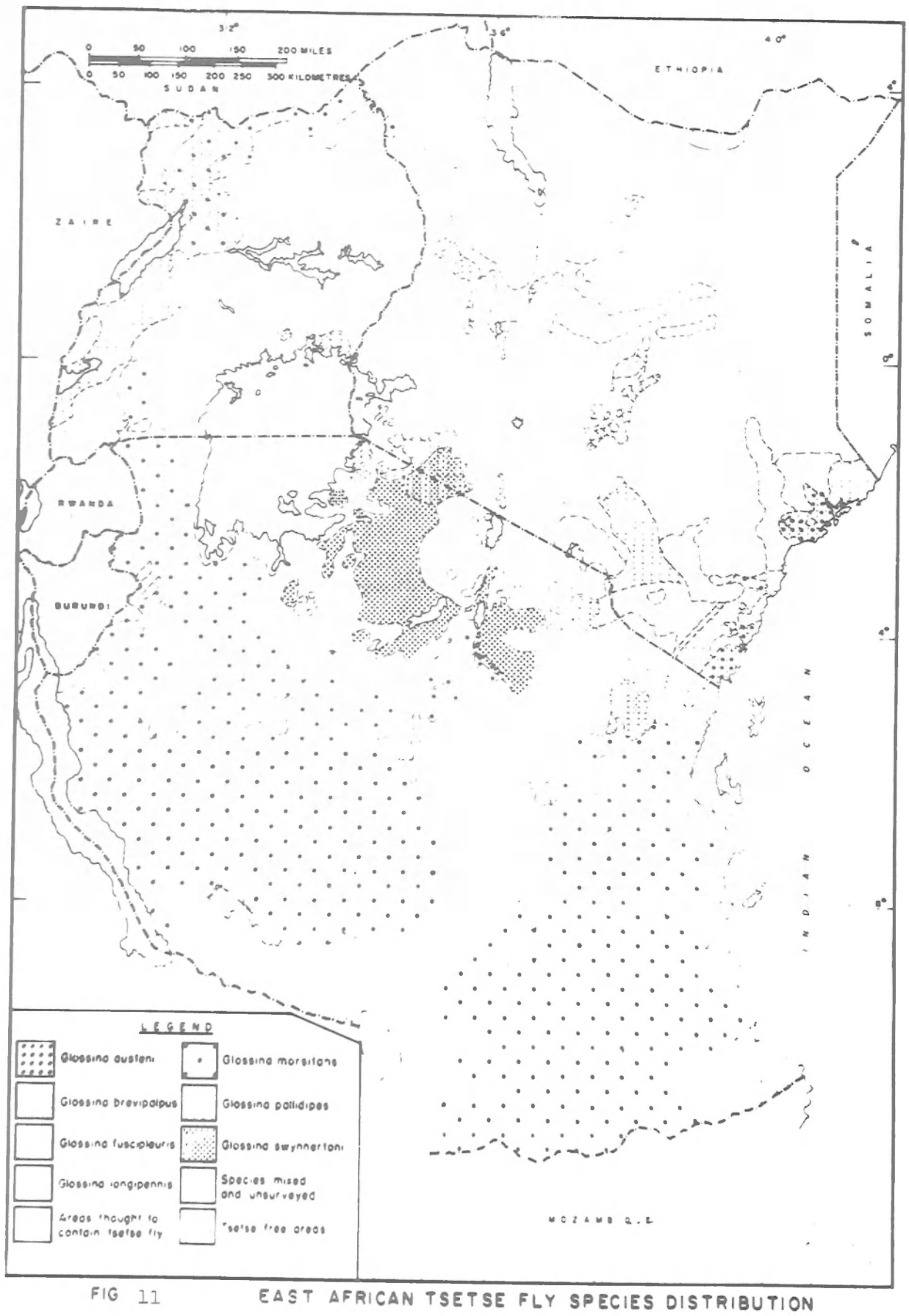


FIG 11 EAST AFRICAN TSETSE FLY SPECIES DISTRIBUTION

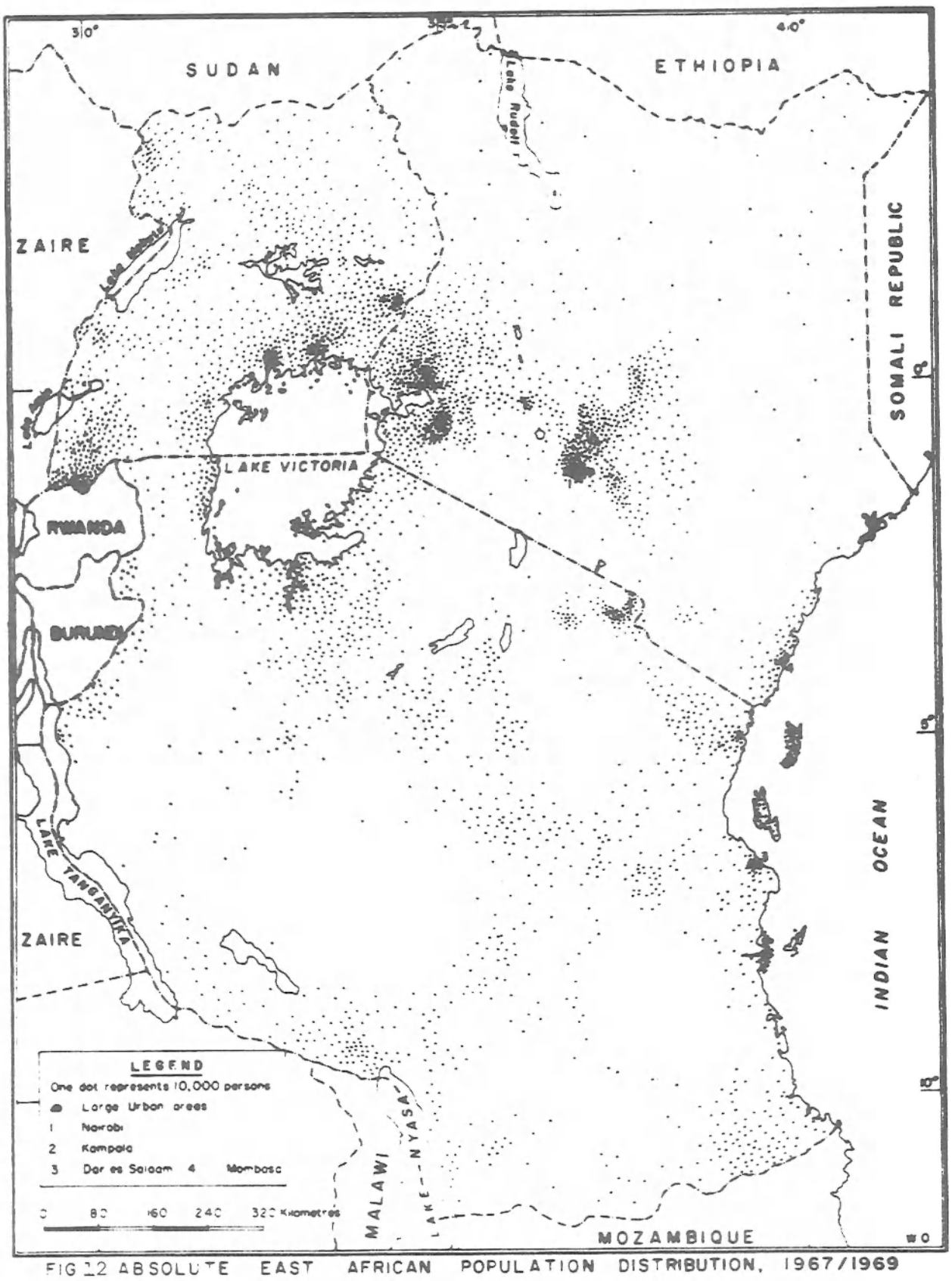


FIG 12 ABSOLUTE EAST AFRICAN POPULATION DISTRIBUTION, 1967/1969

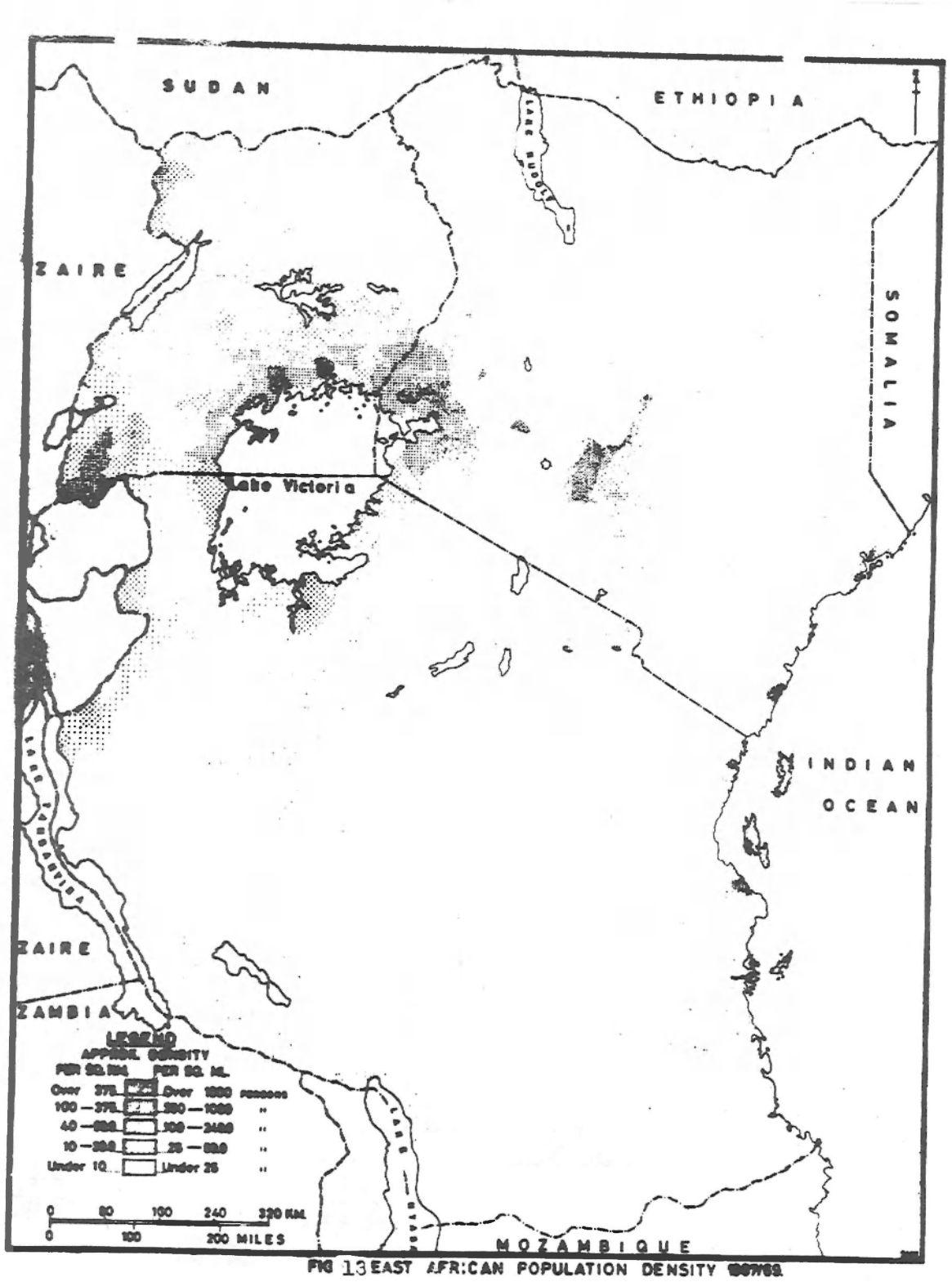


FIG 13 EAST AFRICAN POPULATION DENSITY 1967/68

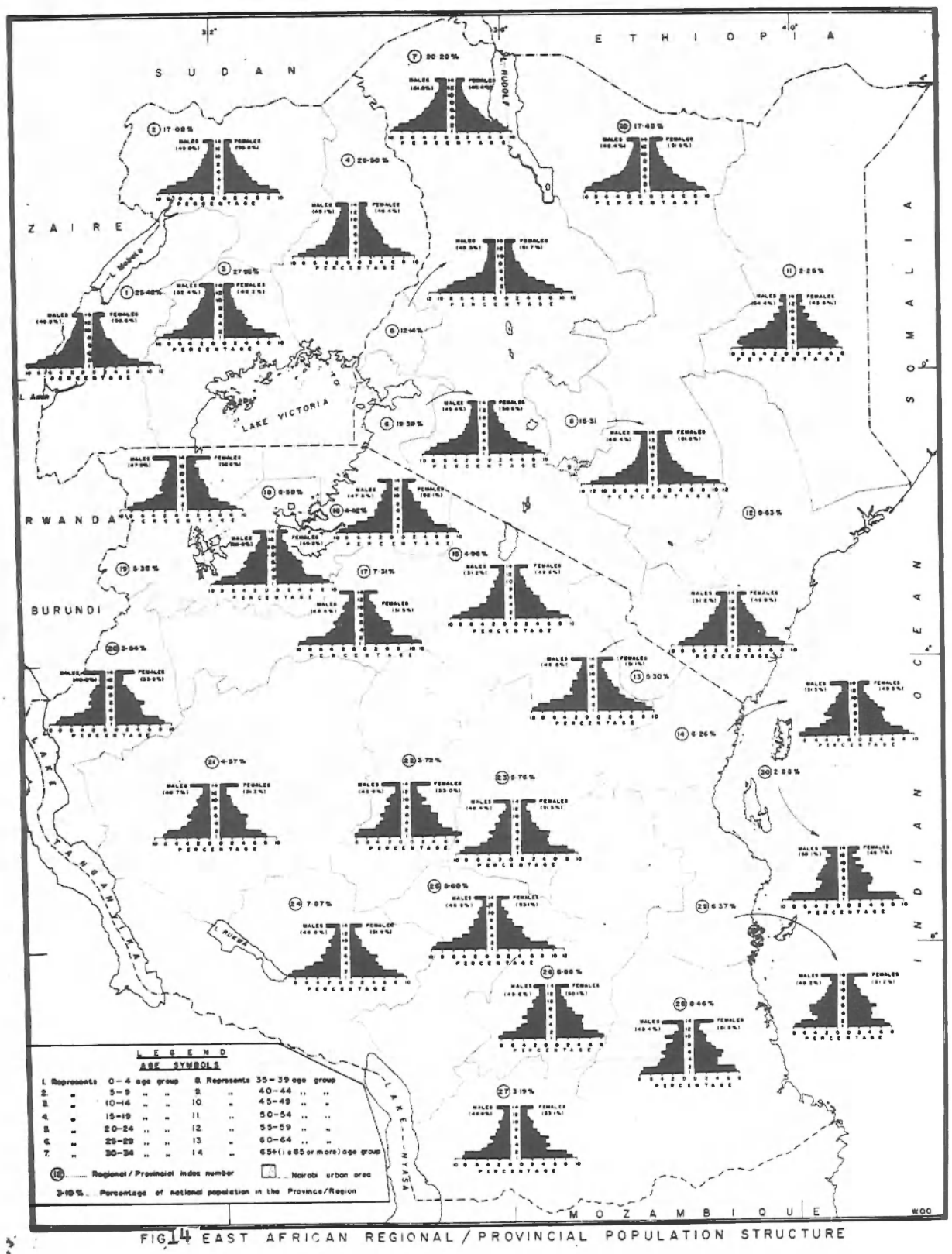


FIG 14 EAST AFRICAN REGIONAL / PROVINCIAL POPULATION STRUCTURE

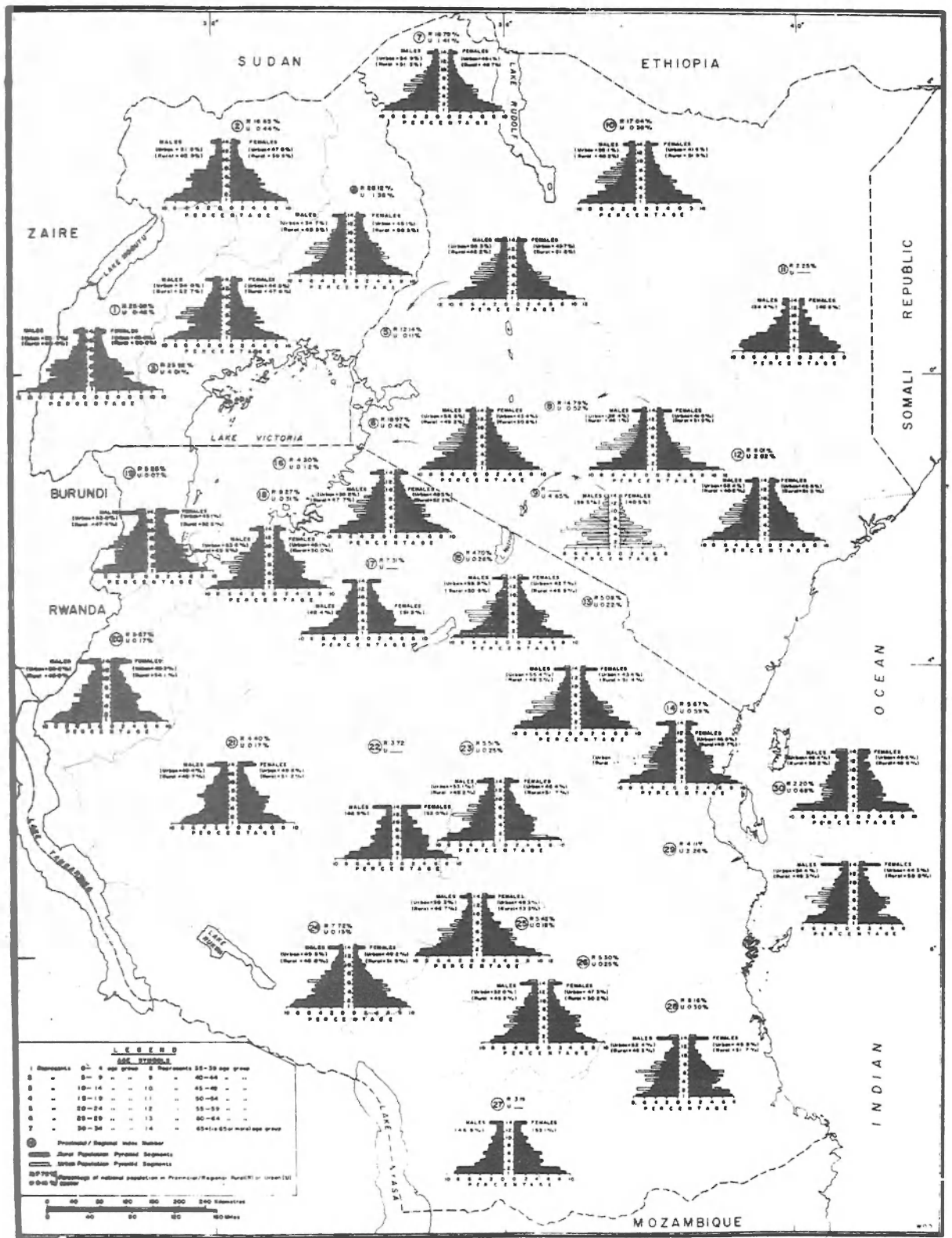


FIG15 E AFRICA: PROVINCIAL/REGIONAL COMPOSITE RURAL-URBAN POPULATION STRUCTURE

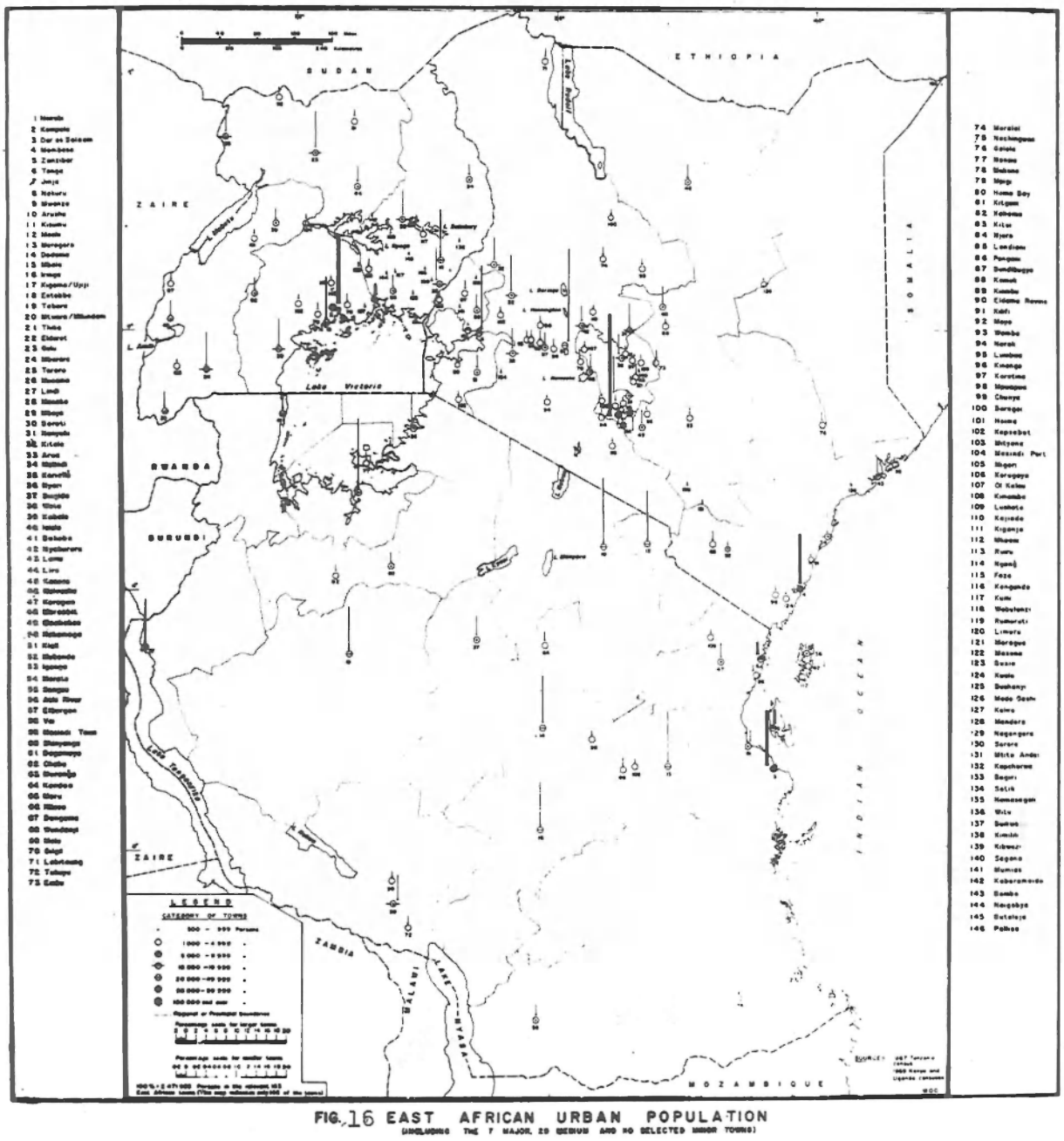


FIG. 16 EAST AFRICAN URBAN POPULATION
(INCLUDING THE 7 MAJOR, 20 MEDIUM AND 90 SELECTED MINOR TOWNS)

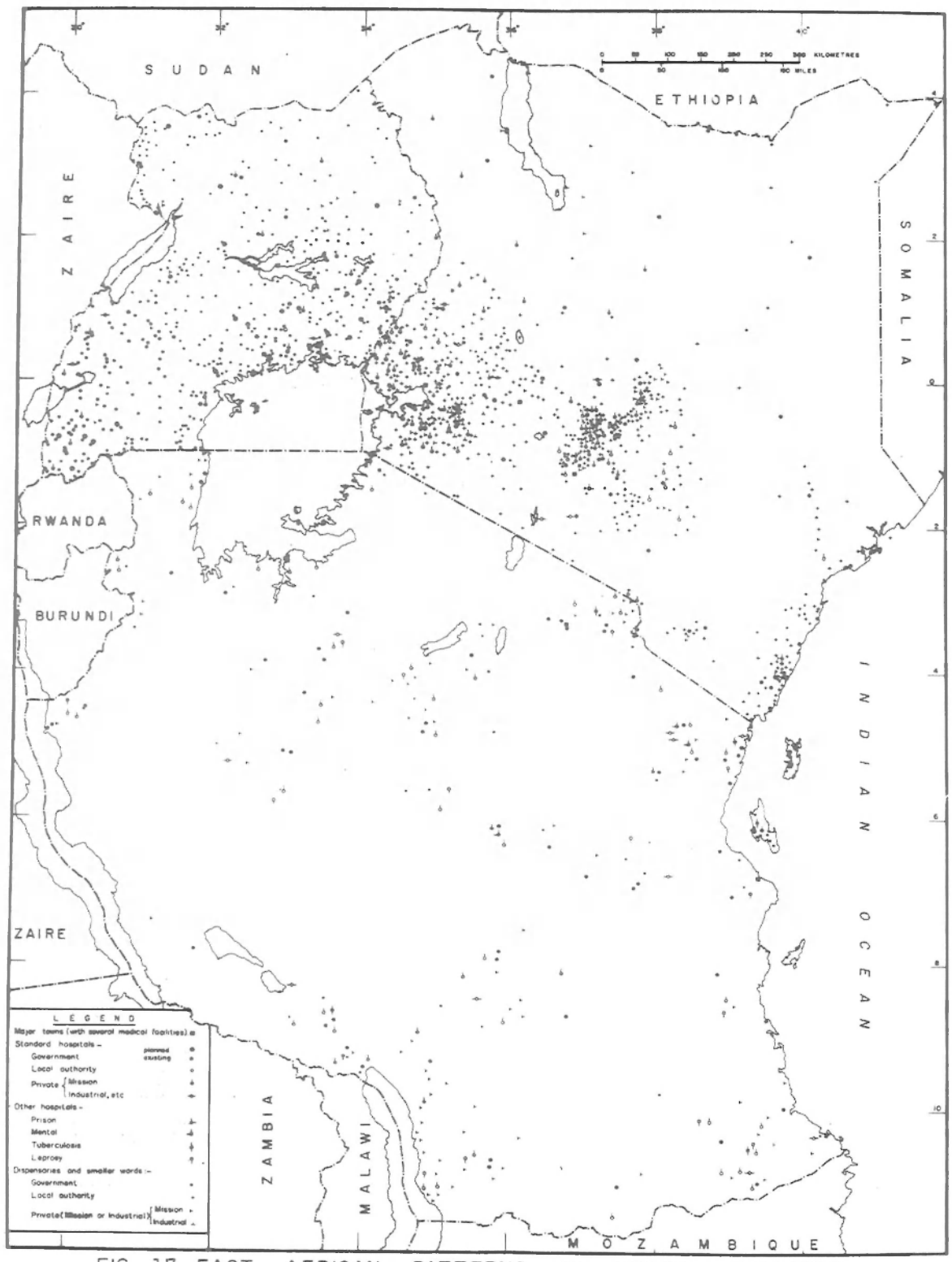


FIG. 17 EAST AFRICAN PATTERNS OF MEDICAL FACILITIES

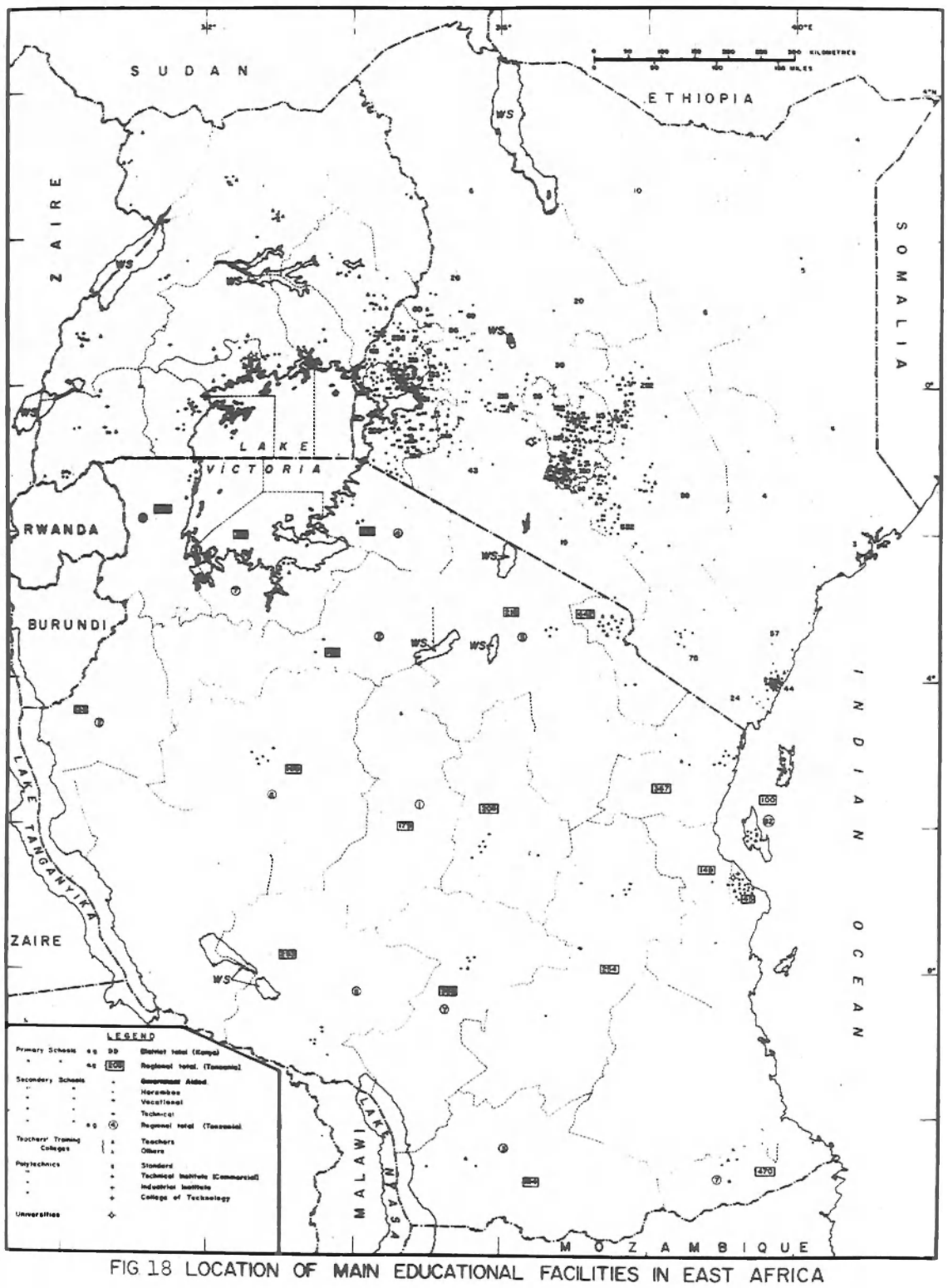


FIG 18 LOCATION OF MAIN EDUCATIONAL FACILITIES IN EAST AFRICA

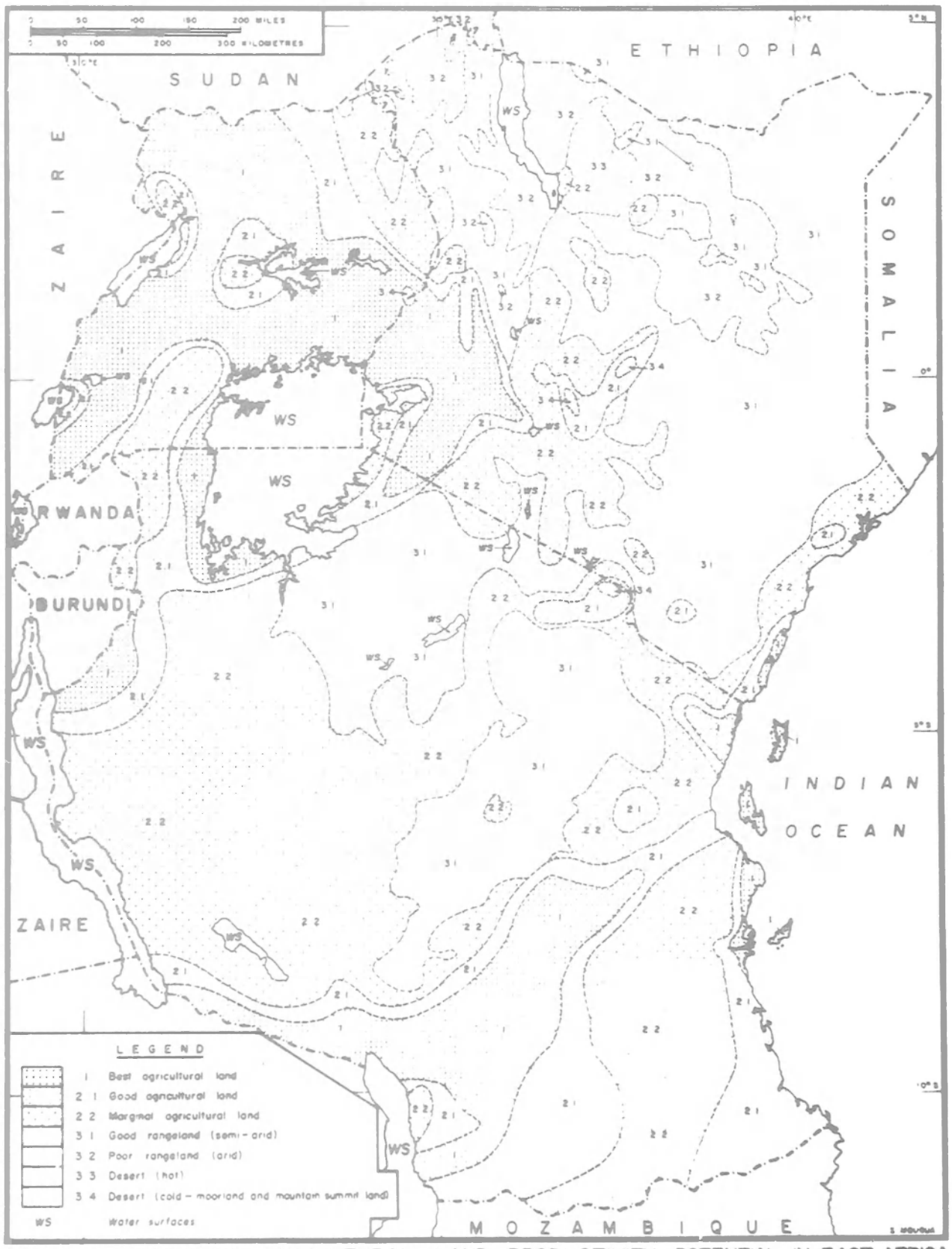
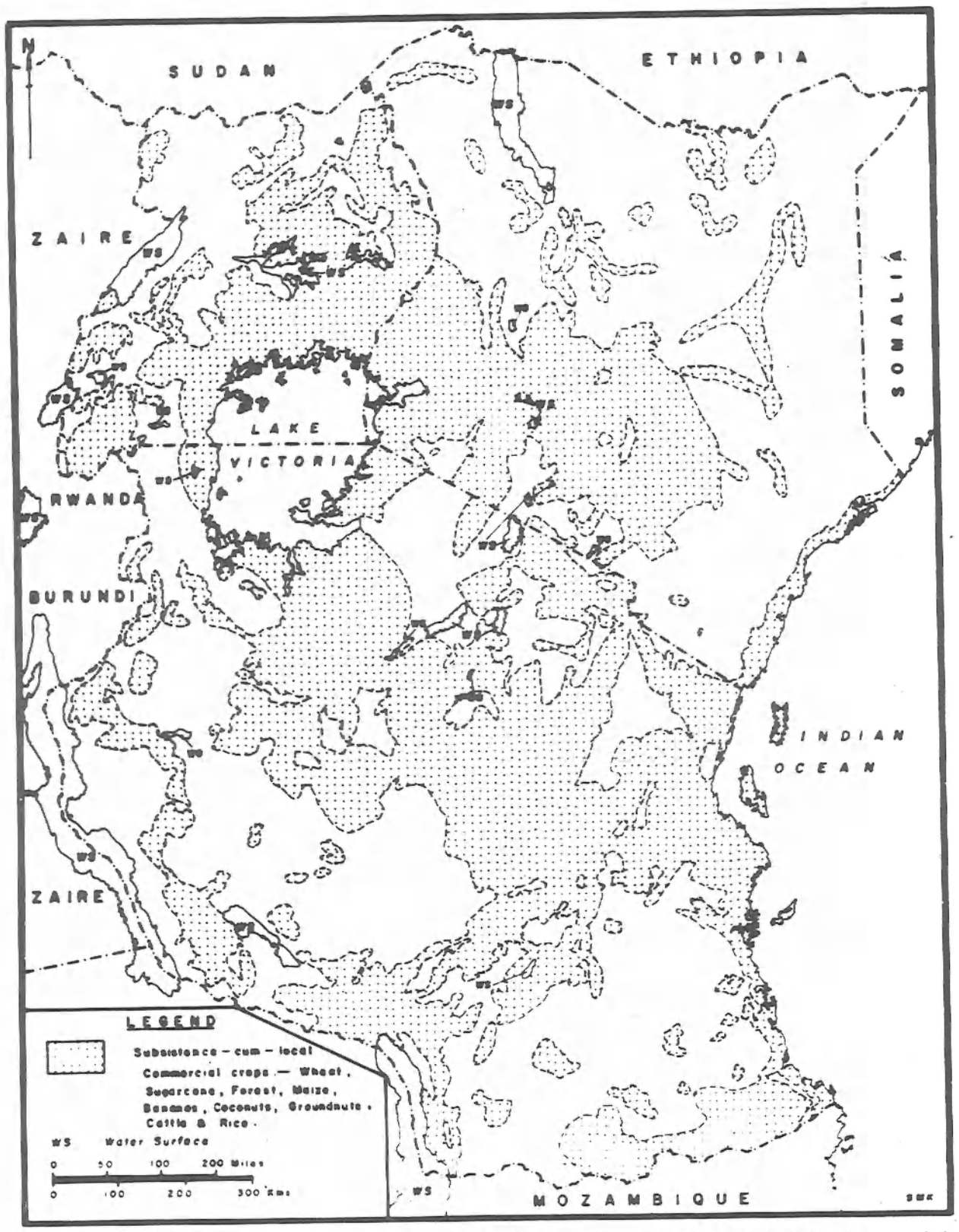
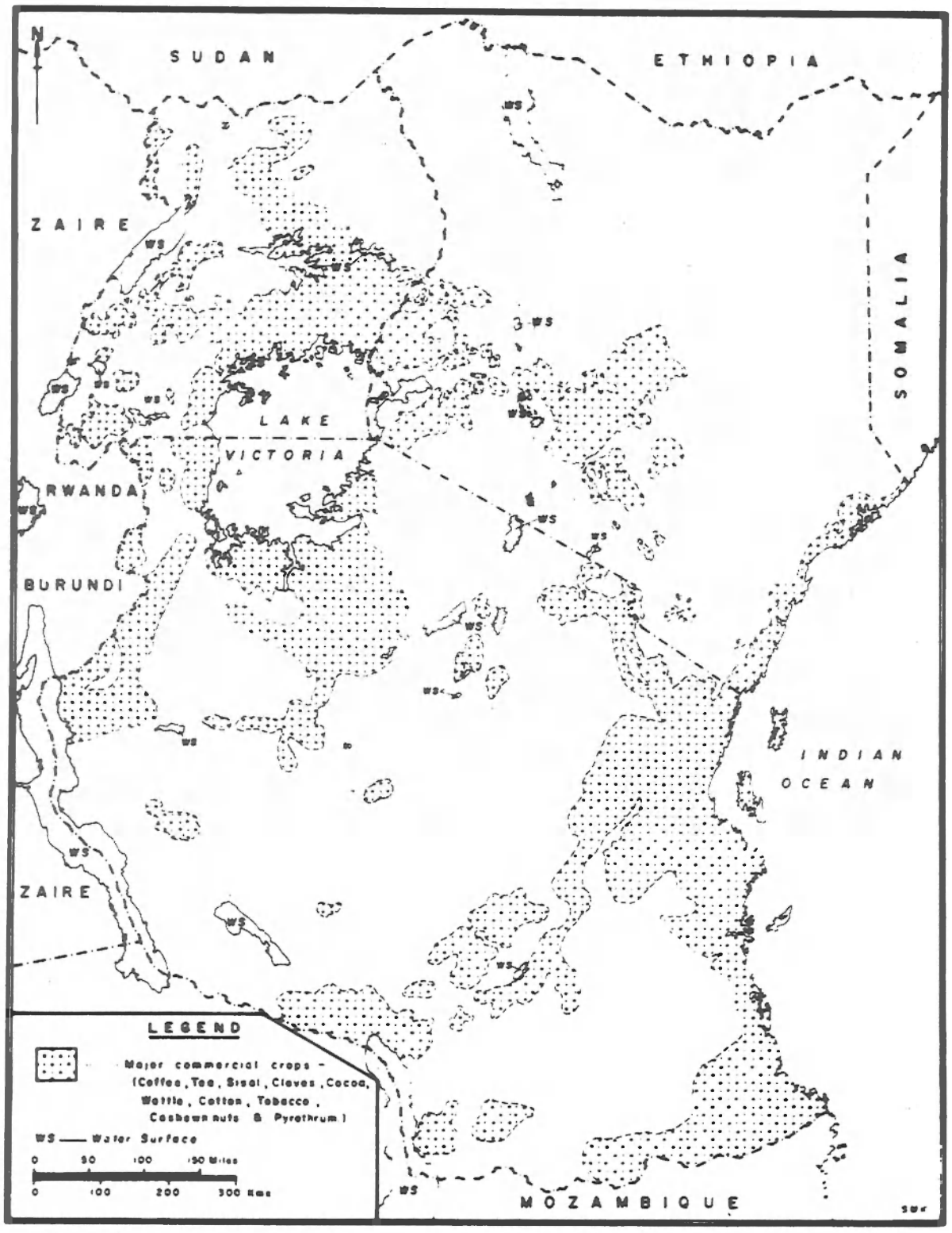


FIG 19 COMPOSITE AGRICULTURAL LAND PRODUCTIVITY POTENTIAL IN EAST AFRICA



Map 20 Composite pattern of East Afri n subsistence - cum - local commercial crops



Map 21 Composite pattern of major East African Commercial crops

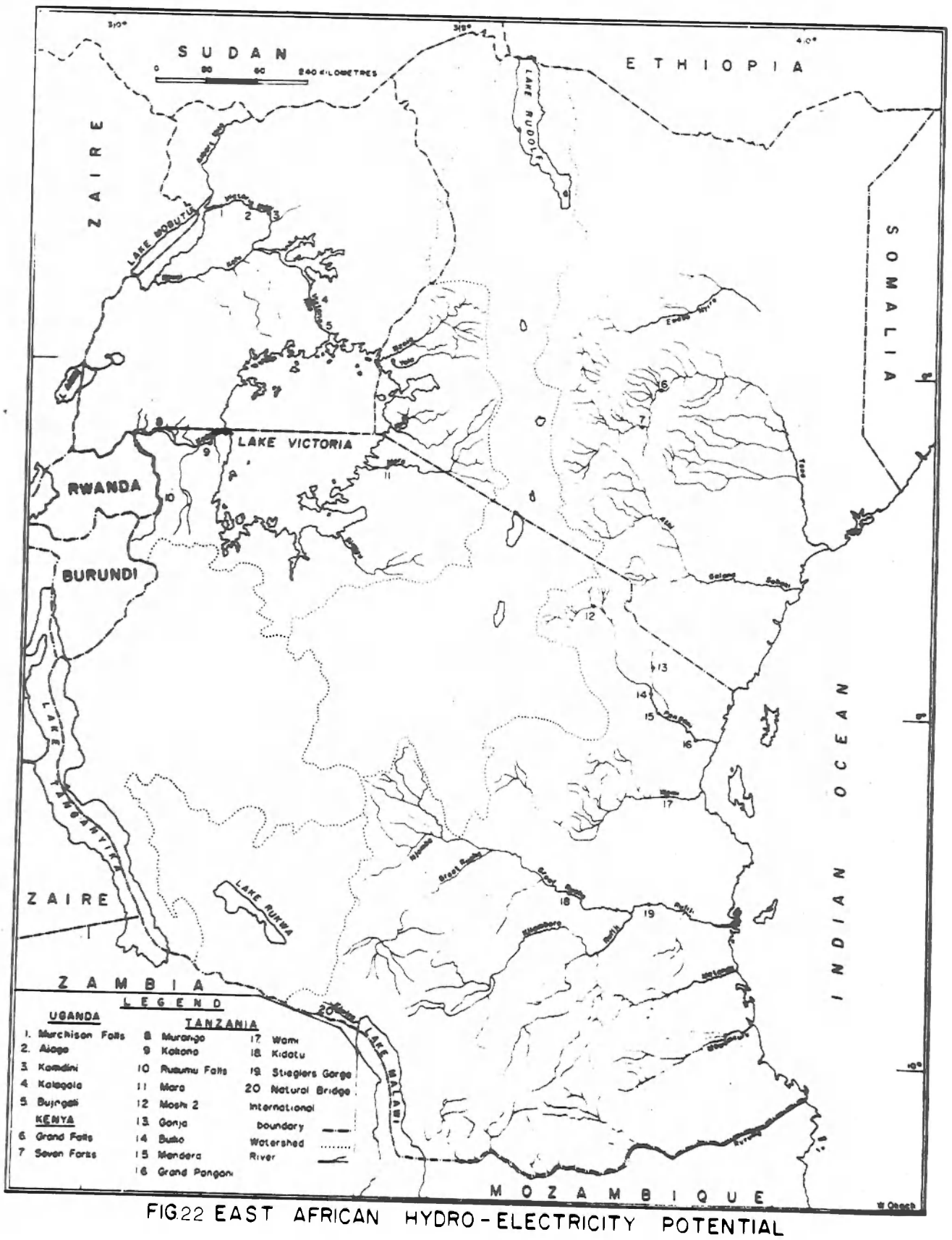


FIG.22 EAST AFRICAN HYDRO-ELECTRICITY POTENTIAL

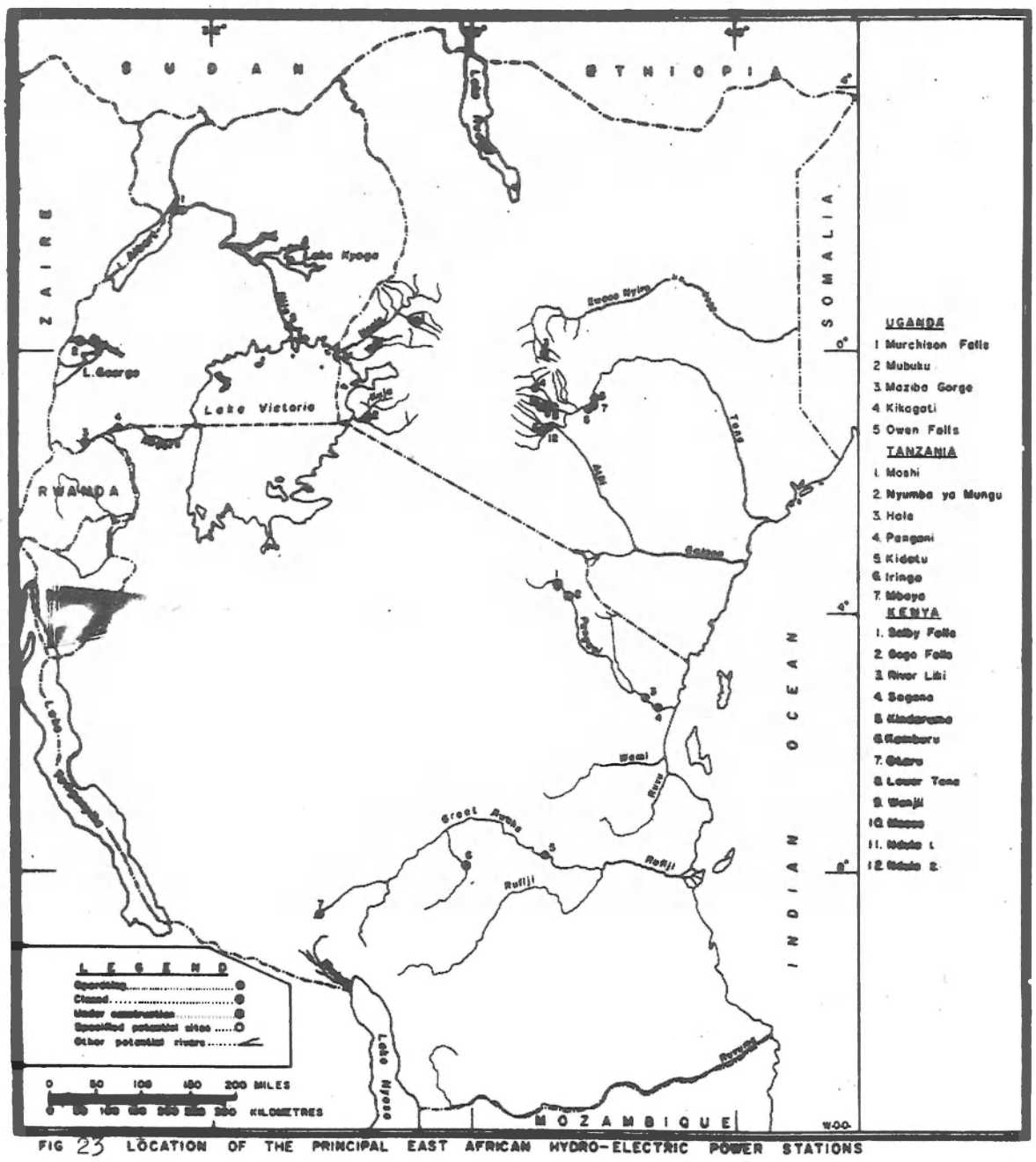


FIG 23 LOCATION OF THE PRINCIPAL EAST AFRICAN HYDRO-ELECTRIC POWER STATIONS

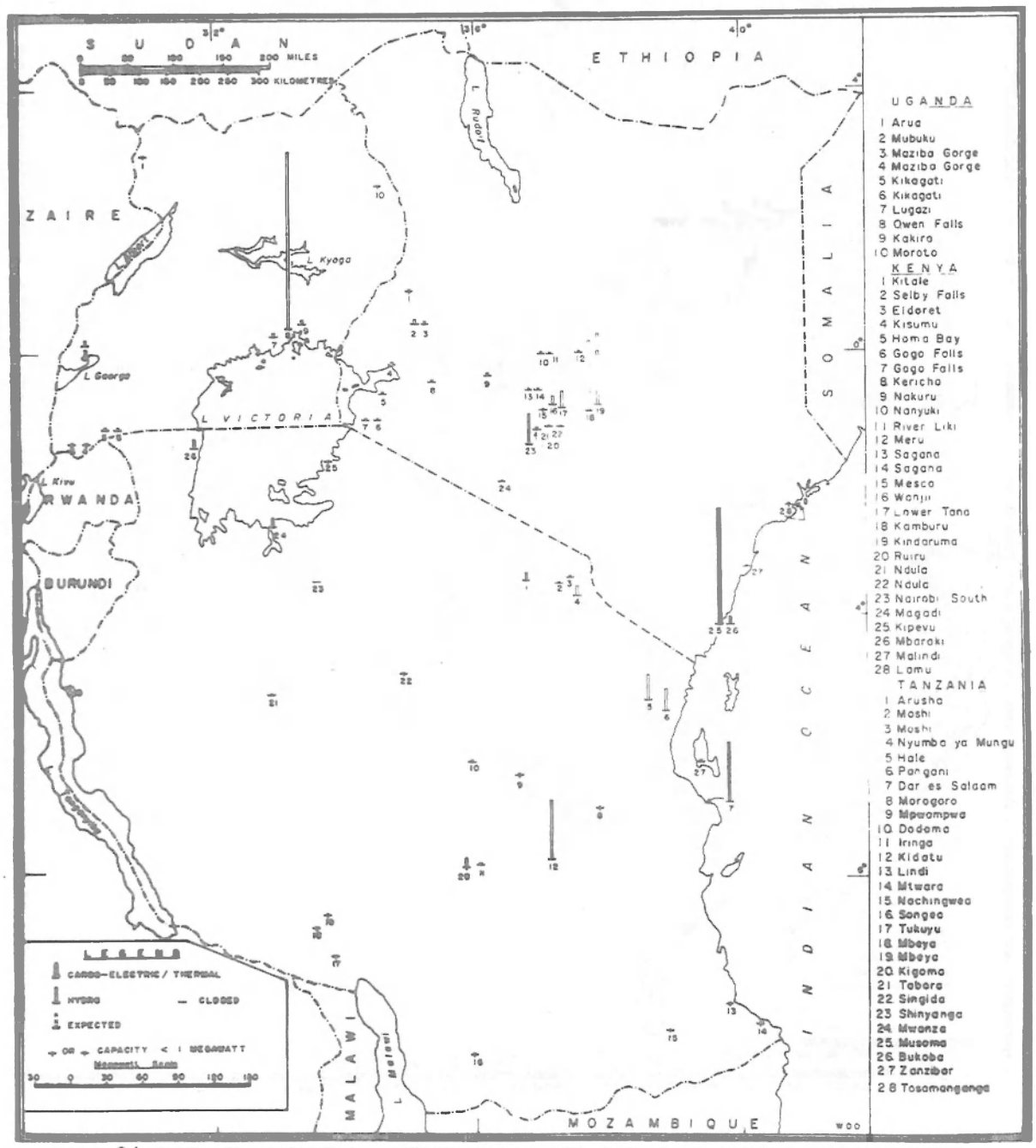


FIG 24 INSTALLED CAPACITY (IN MEGAWATTS) OF THE MAIN EAST AFRICAN POWER STATIONS

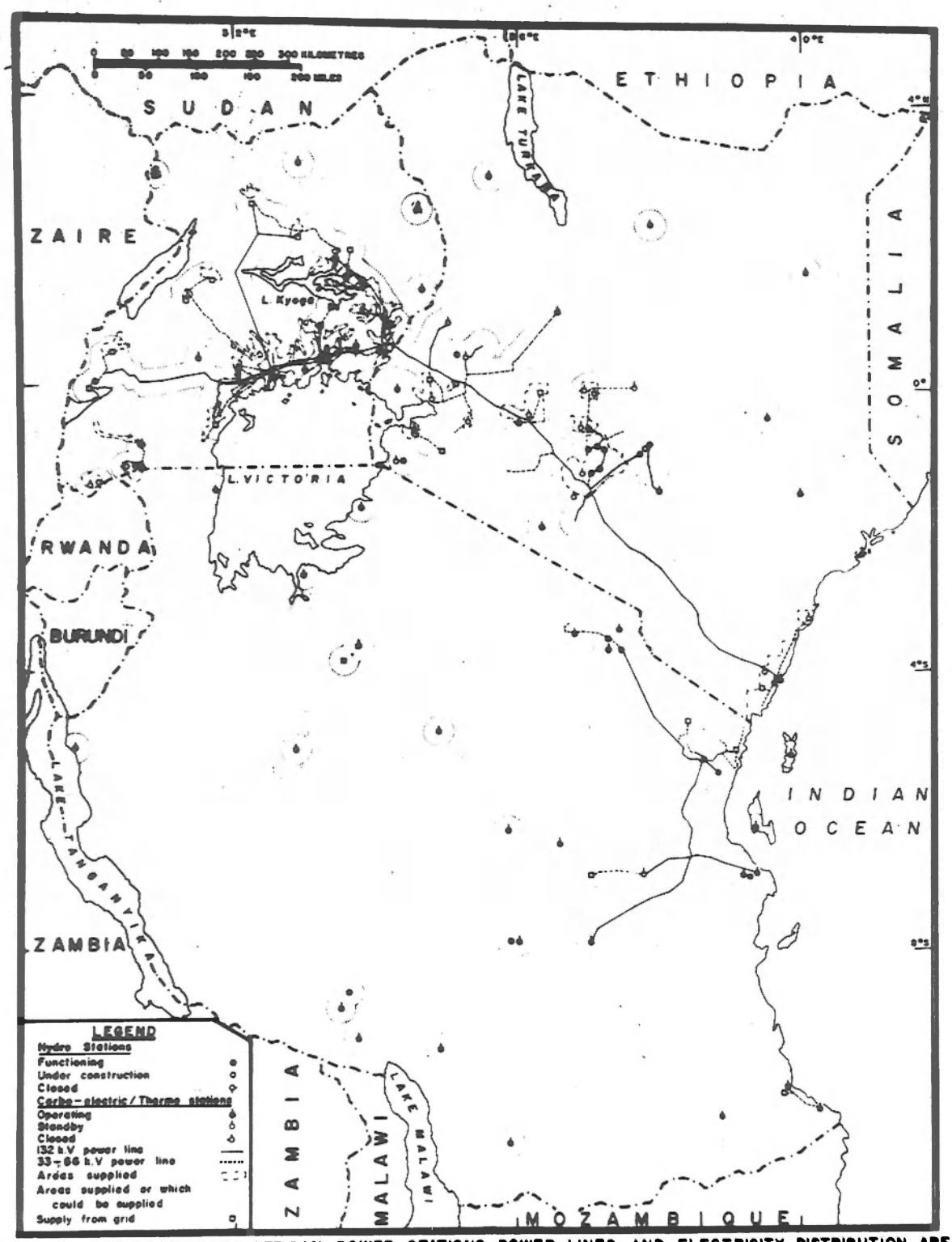


FIG 25 PATTERNS OF EAST AFRICAN POWER STATIONS, POWER LINES AND ELECTRICITY DISTRIBUTION AREAS

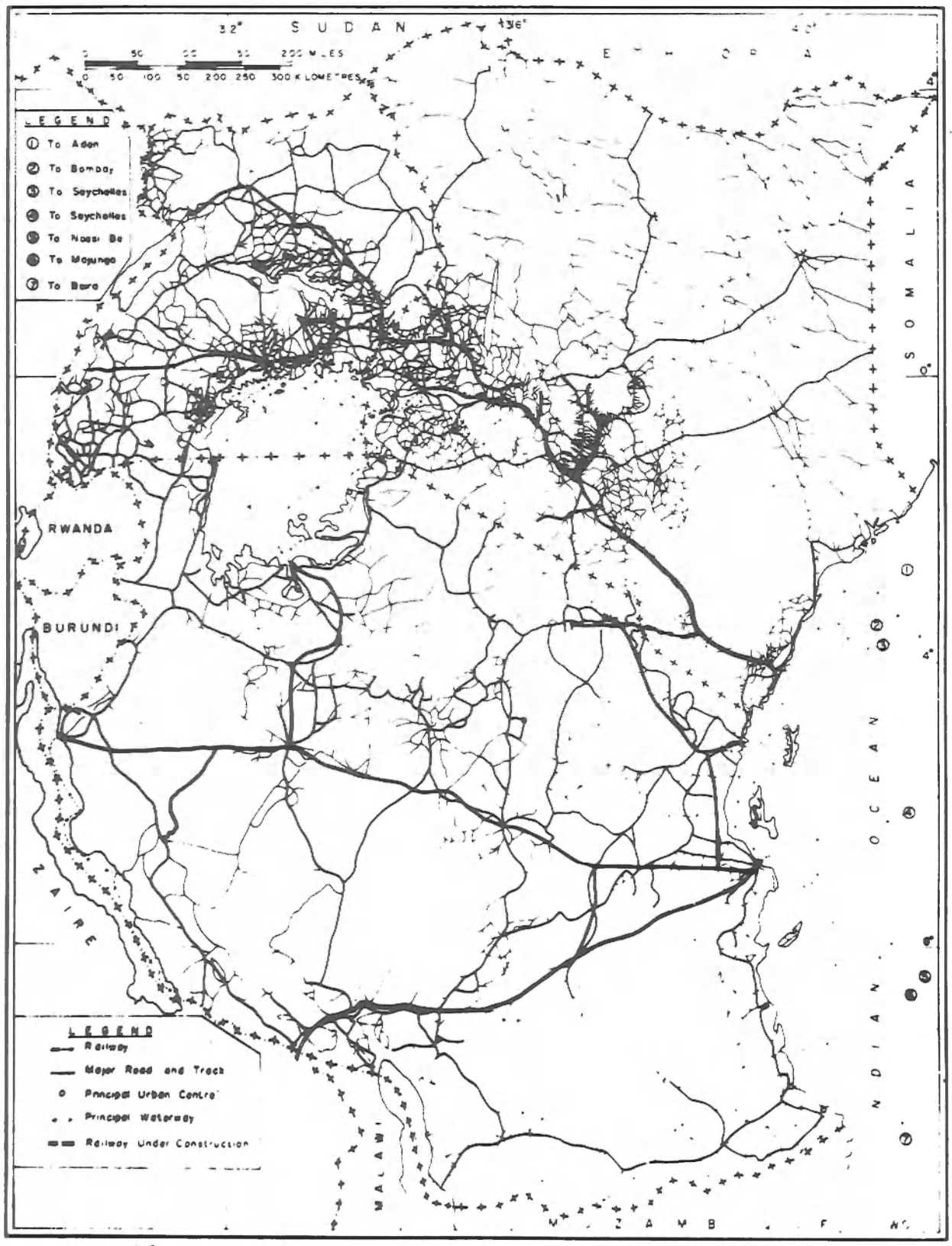


FIG 26 EAST AFRICAN RAILWAYS ROADS AND PRINCIPAL WATERWAYS

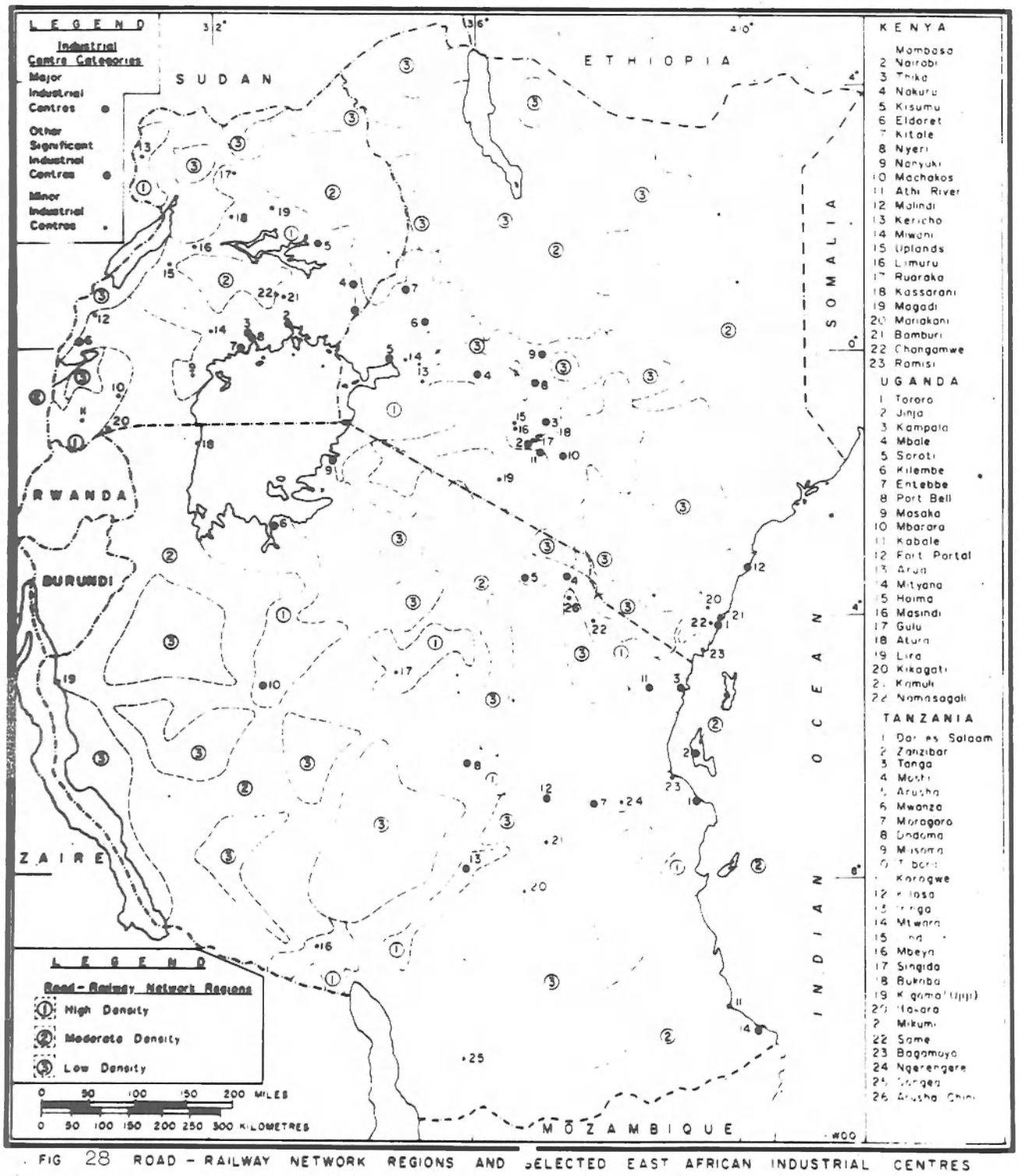


FIG 28 ROAD - RAILWAY NETWORK REGIONS AND SELECTED EAST AFRICAN INDUSTRIAL CENTRES

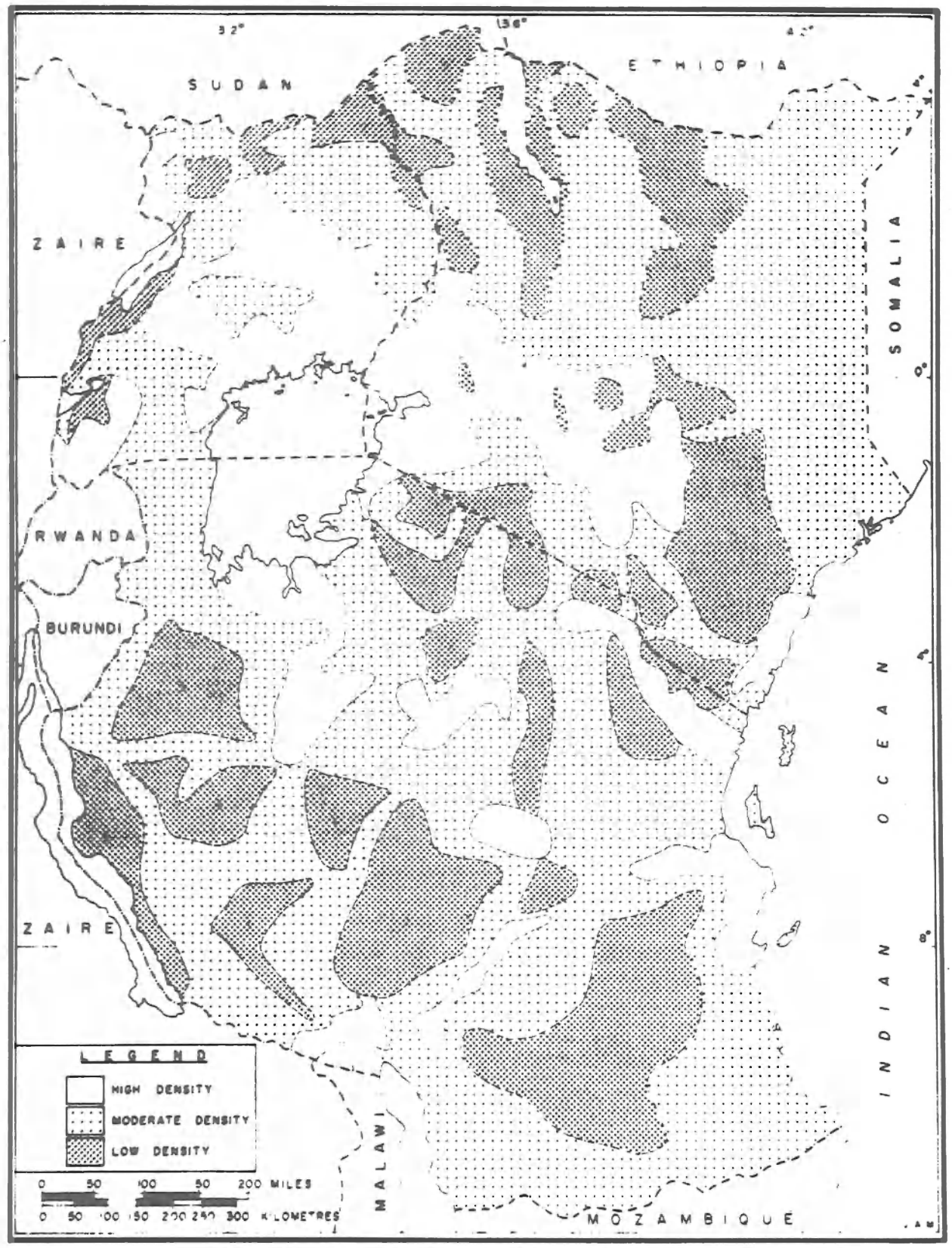


FIG 27 RAILWAY AND ROAD DENSITY REGIONS OF EAST AFRICA

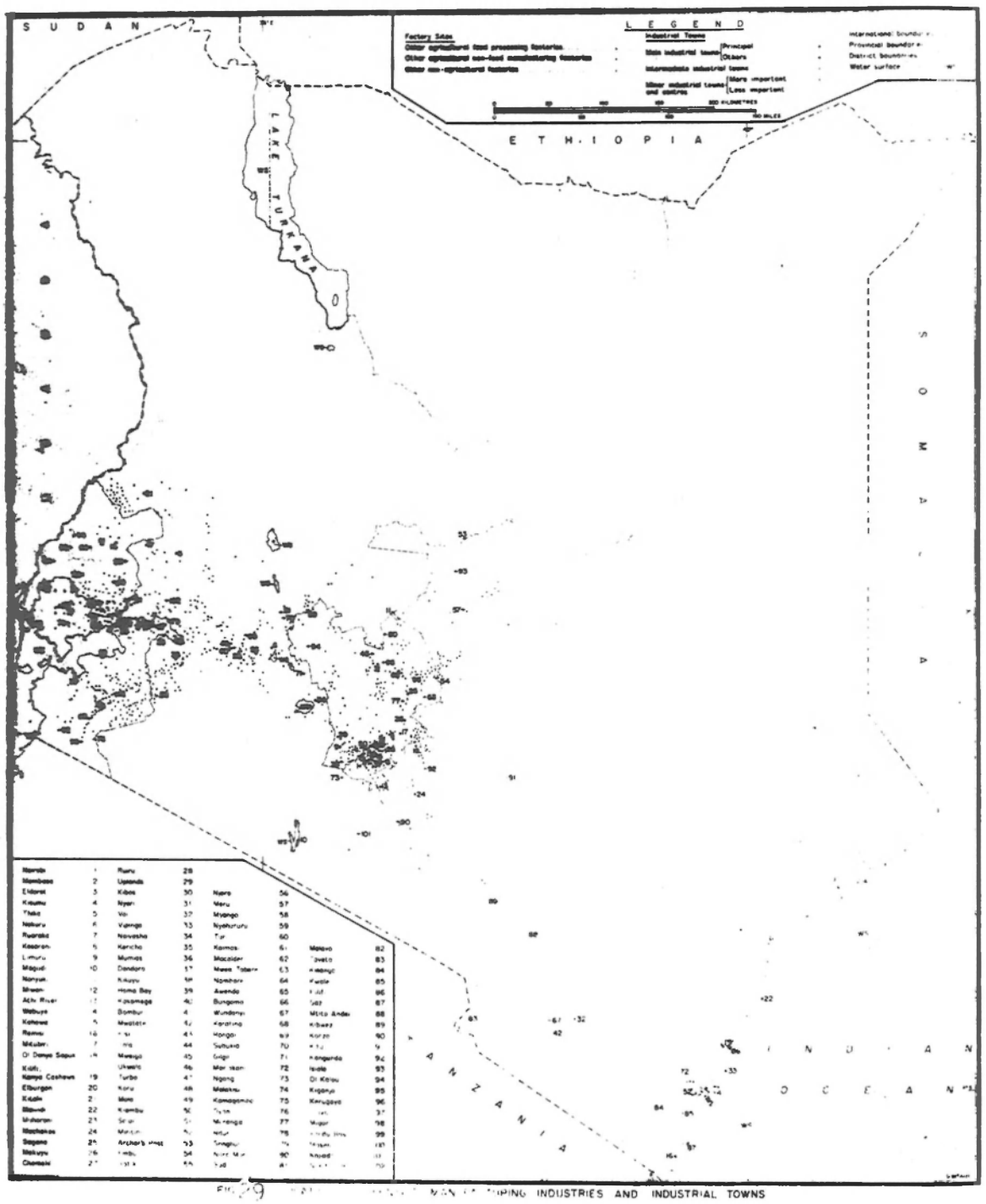


FIG. 9 MANUFACTURING INDUSTRIES AND INDUSTRIAL TOWNS

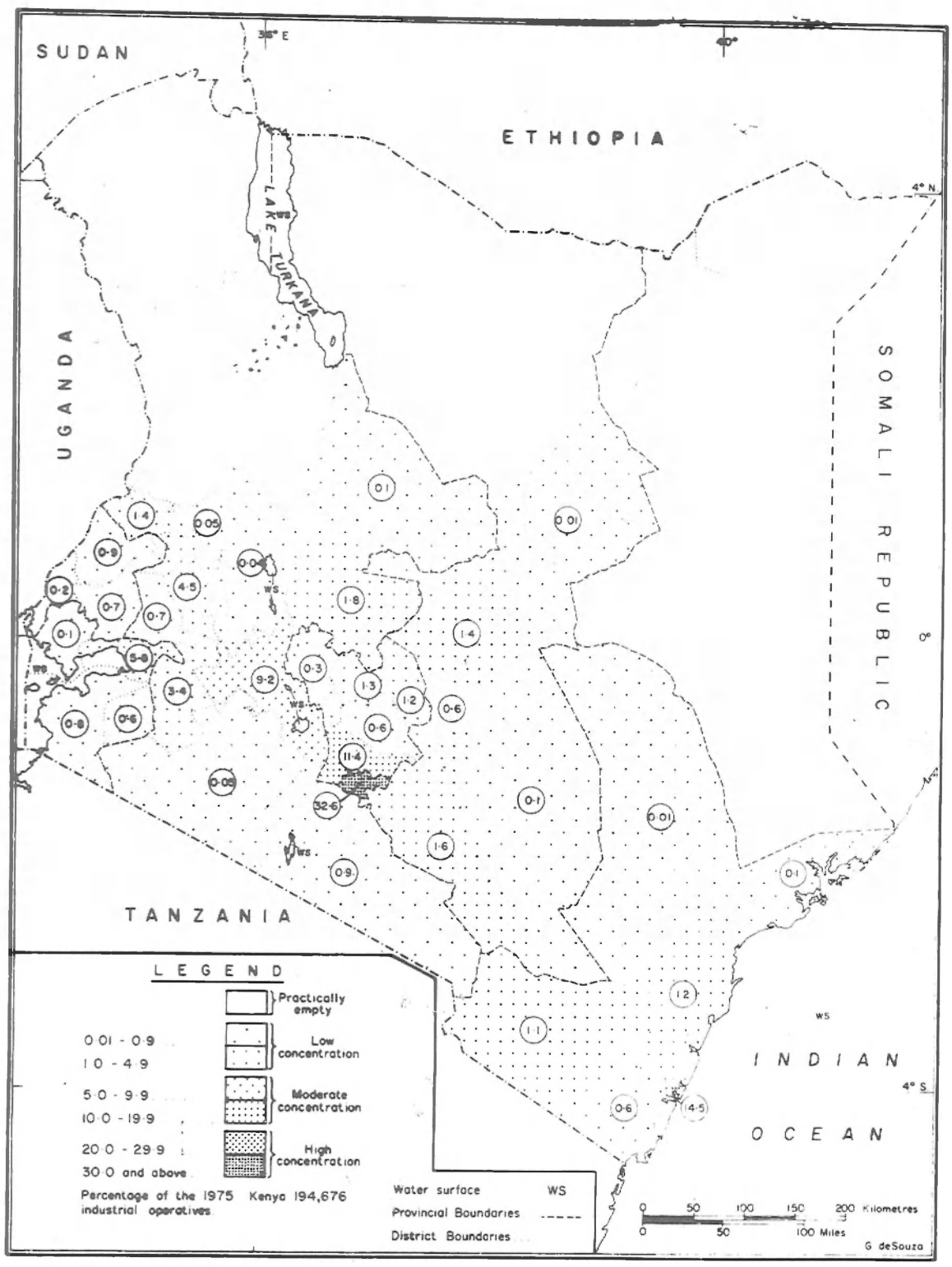


FIG. 30 LOCATION OF MANUFACTURING AND SERVICE INDUSTRIES IN KENYA

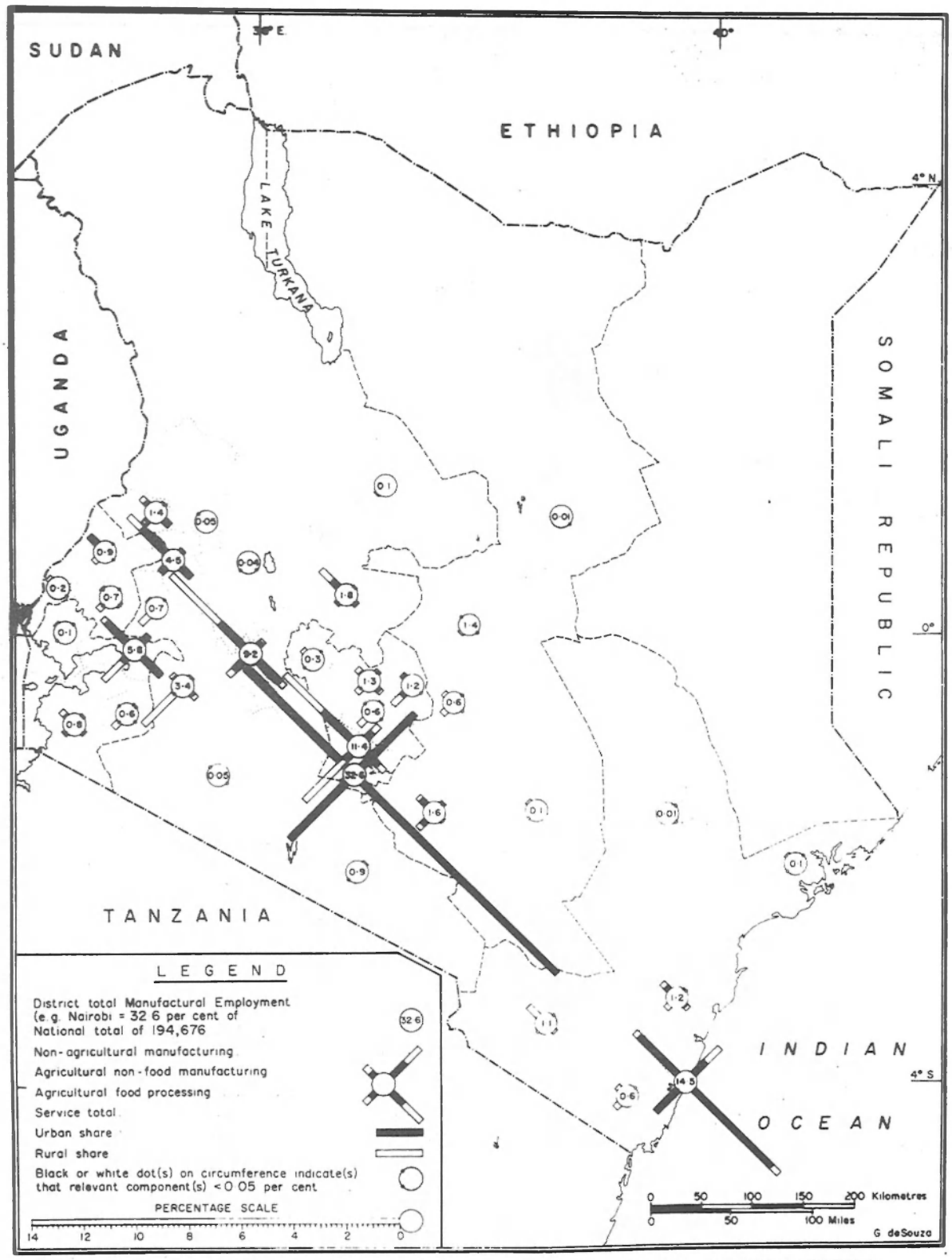


FIG. 31 STRUCTURAL DISTRIBUTION OF KENYA'S 194,676 MANUFACTURING AND SERVICE OPERATIVES IN 1975.

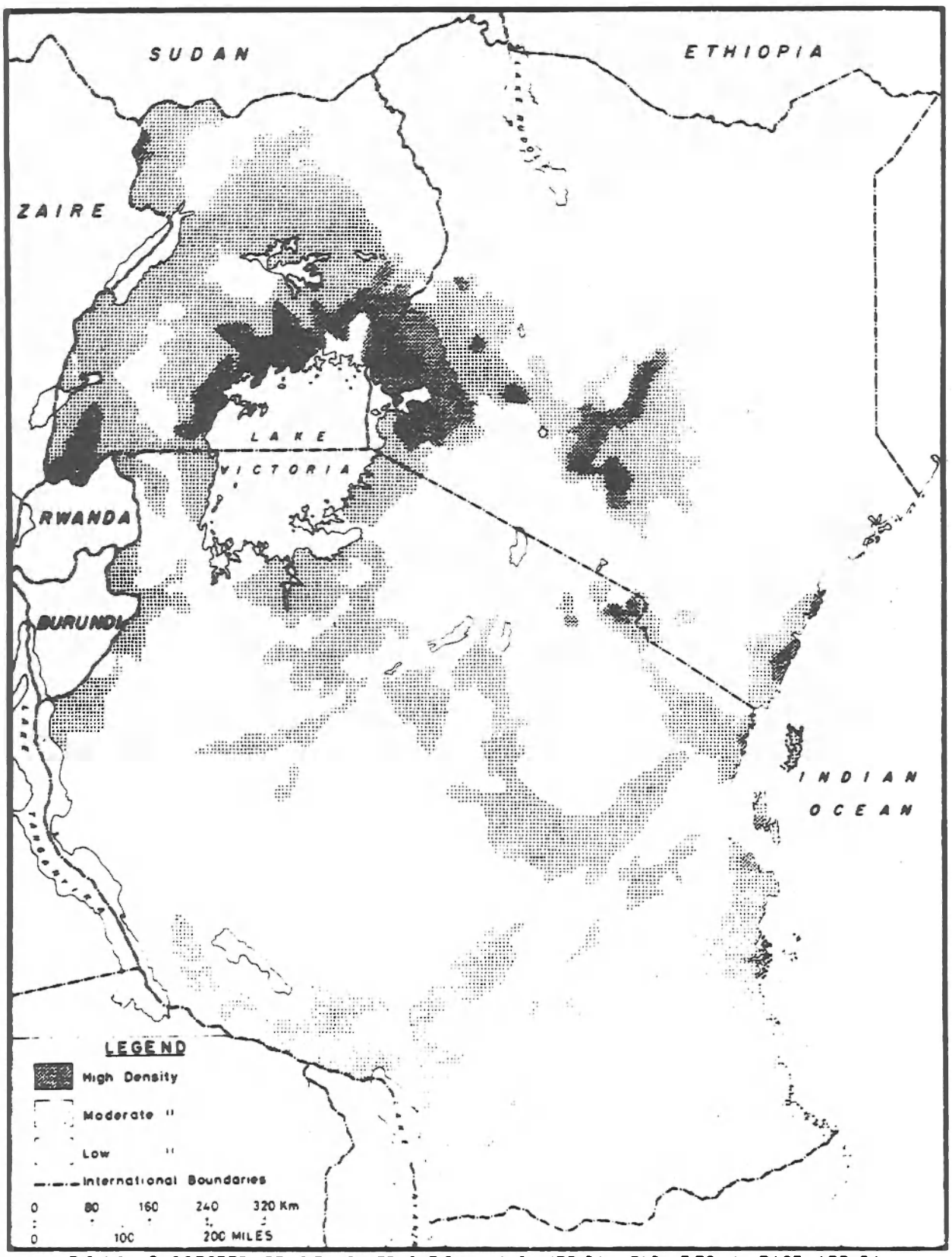


FIG 32 SUGGESTED DENSITY OF EDUCATIONAL AND MEDICAL FACILITIES IN EAST AFRICA

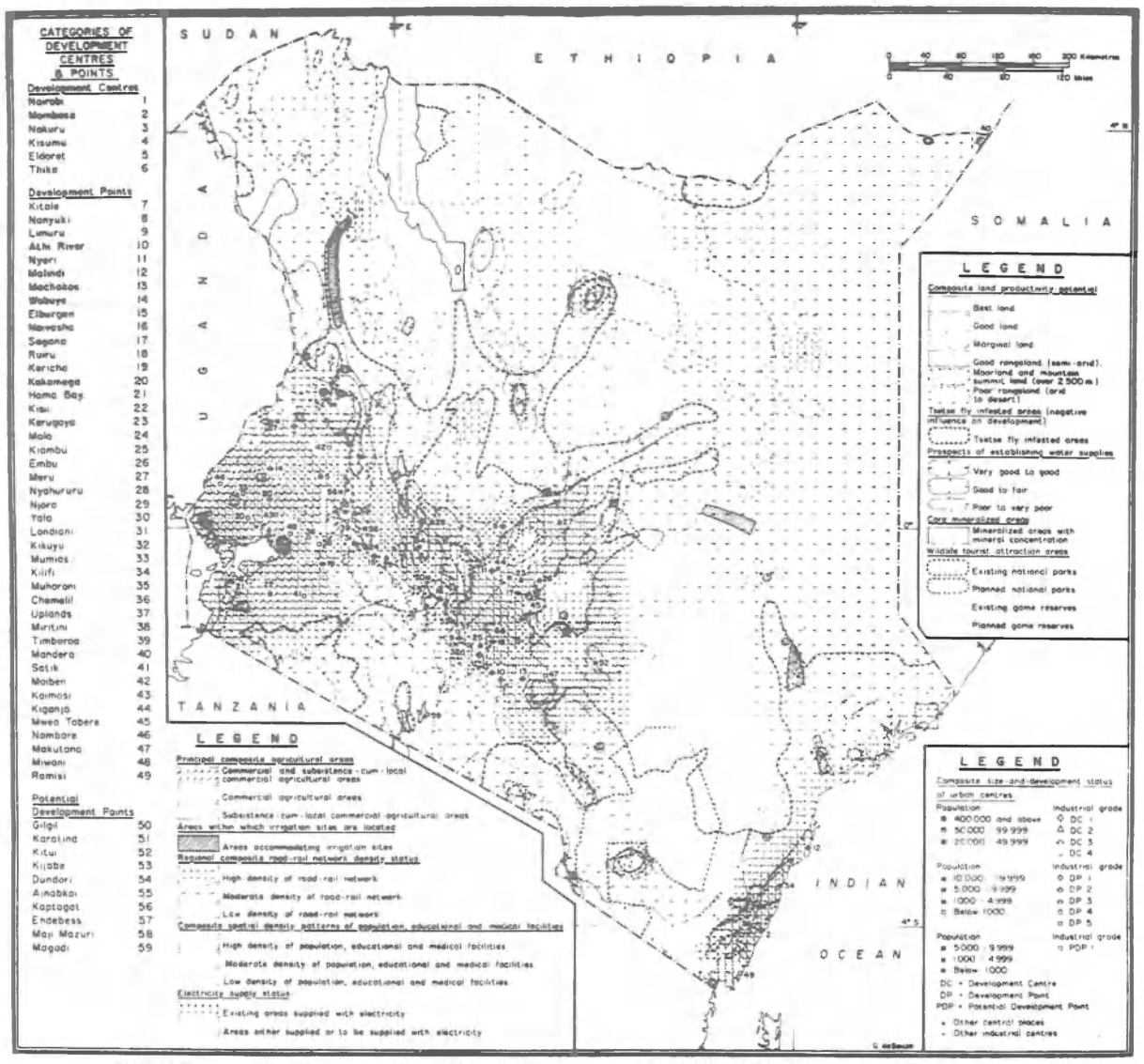


FIG. 33 . PATTERNS OF MAJOR FACTORS INFLUENCING ECONOMIC DEVELOPMENT PLANNING IN KENYA.

FISH SPECIES, DISTRIBUTION AND ABUNDANCE

By

N. Odero
Director of Fisheries
Ministry of Tourism and Wildlife
Kenya.

INTRODUCTION

Lake Victoria contains many types and species of fish some of which have only recently been introduced. These fish types include Tilapia, Bagrus, Barbus, Clarias, Mormyrus, Protopterus, Haplochromis, Labeo and Engraulicypris species and the Nile Perch, Lates niloticus. All the fish in the lake are edible, but the consumer preference is variable.

The Lake is fed by many fresh water rivers and streams, the major ones in Kenya being Sio, Nzoia, Yala, Nyando, Miriu and Kuja. The Lake is further fed by the flood waters of the torrential rains which are characteristic of the region. Pritchard (1966) states that the broad zone surrounding Lake Victoria although modified by altitude has equatorial climatic conditions and the rainfall is quite heavy, ranging between (45 and 80 inches) 1000 to 2000 mm. per year.

The flood waters often cause disasters by washing away homesteads and cultivated lands. On the other hand however, floods attract large numbers of anadromous and mud-dwelling fishes which are easily captured by the indigenous people, especially at the river mouths. Flood water fishing proved detrimental to the anadromous fish most of which were in the past caught in large quantities on their upstream spawning migration.

The fish stock abundance was in the past calculated from the catch returns obtained from the various fishermen operating around the Lake. In recent years these estimations have been made from bottom trawl surveys which have been conducted since 1968. However, records are still being maintained of the landings of various types and/or species of fish caught by the fishermen using different fishing methods. As early as 1960 Garrod had already indicated that from the available catch statistics then fishing activities showed increasing intensity which were leading to varying degrees of depletion of the inshore, more accessible fishing grounds.

TYPES OF FISH.

The fishes of Lake Victoria are divided into two major groups. These are the Cichlids comprising of Tilapia and Haplochromis species and the Non-cichlids which include Bargus docmac, clarias species, Protopterus aethiopicus, Labeo victorianus, Schilbe mystus and Lates niloticus.

The types of fish may also be grouped into the endemic species and non-endemic ones. Lowe-McConnel (1975) prints out that of the non-cichlid species 16 are endemic. It is known that two species of Tilapia; T. esculenta and T. variabilis are endemic to the Lake.

Many types of fish in Lake Victoria are anadromous, migrating up affluent rivers during the time of floods to spawn (Cadwalladr 1965). The twice-yearly floods are thus beneficial to the river fisheries and several indigenous fishing methods (in some areas now superseded by modern fishing methods) were evolved to exploit the concentrations of migrating fish. The fishes most often associated with the rivers and the flood fisheries are Protopterus aethiopicus. small mormyrid species, Alestes species, Labeo victorianus, Barbus altianalis smaller Barbus species, Schilbe mystus clarias species, Synodontis species, Aplocheilichtyps pumilus, Astatoreochromis alluaudi and Ctenopoma muriei.

All species of fish in Lake Victoria are edible and could in one form or another be used as food for human consumption. In a report by EAFFRO (East African Freshwater Fisheries Research Organization) (1955/1956) an attempt was made to compare the species by value and the fishes were divided into 6 groups:

1. Cichlid species (a) Tilapia i. T. esculenta
   ii. T. variabilis
2. Mormyrid species (Mormyrus kanume).
3. Labeo.
4. Schilbe, Bagrus, Clarias.
5. Protopterus aethiopicus.
6. Barbus.

Basing the assessment on the fish production from the Lake Garrod (1960) listed the most important species as Tilapia-esculenta, Tilapia variabilis, Bagrus docmac, Barbus-altianalis, Mormyrus kanume, Clarias mossambicus and Protopterus aethipicus. In the recent years the production by species has changed greatly

and list of important species may be entirely different as may be observed from production tables given here below (Tables 1-3). Three species of fish, however, though contributing insignificant amount in the catches at the moment are still considered very important and highly desirable in the Kenyan sector of the Lake. These are the Tilapia esculenta, Barbus altianalis and Labeo victorianus.

Table 1. Average Catch in KG/HAUL from 1969/70 Experimental Trawling.

ZONE	I	II	III	IV	V	VI	VII
No. of Hauls	7	12	30	6	18	23	13
Tilapia nilotica	0	.09	.15	5.1	0	0	0
T. Variabilis	.1	.15	.12	.42	0	0	.12
T. esculenta	7.7	9.3	9.7	28.0	1.2	4.0	1.2
Haplochromis and allies	138.0	172.0	71.0	50.0	429.0	141.0	143.0
Bagrus docmac	9.7	77.0	148.0	59.0	24.0	31.0	17.0
Schilbe mystus	.05	.14	.47	.25	.19	.24	.26
Clarias mossambicus	7.5	19.0	38.0	56.0	31.0	38.0	13.0
Protopterus aethiopicus	9.2	21.0	17.0	30.0	.17	2.6	14.0
Mormyrus kannume	0	.03	.47	.12	.22	.59	.85
Lates niloticus	0	.0	.17	5.9	0	0	0
Synodontis spp.	.1	15.0	1.5	1.0	11.0	2.5	2.5
Barbus altianalis	0	0	.1	.17	.21	.04	.08
Labeo victorianus	.07	0	.007	.25	.14	.04	.01

Table 2. Average Catch in KG/Haul from 1975 Experimental Trawling.

ZONE	I	II	III	IV	V	VI	VII
No. of Hauls	39	30	45	41	21	14	12
T. nilotica	.25	1.6	.8	40	.05	.3	0
T. Variabilis	.37	.6	.1	3.7	1.7	0	0
T. esculenta	.09	.02	.02	.04	.07	.1	0
Haplochromis and allies	123	175	188	140	98	26	223
B. docmac	58	53	103	29	32	24	6.6
S. mystus	.18	2.0	.5	.2	.7	2.3	.23
C. mossambicus	10	14	8.6	55	5.2	21	1.2
P. aethipicus	56	39	31.2	14	3.1	3.6	5.8
M. kannume	.03	6.6	.04	.06	.4	.6	0
L. niloticus	1.2	6.9	12.8	68	4.1	5.4	0
Synodontis sp.	.95	.51	.16	3.5	.44	3.7	.78
B. altianalis	.01	.01	.004	.21	.09	0	1.01
Labeo victorianus	1.01	.03	.2	2	.01	0	.02

Table 2 contd.

Source: From Marten et al (1975).

Table 3. Lake Victoria (Kenya) Catch by Species 1976-1978.

Species	1976	1977	1978
	M.Tons	M.Tons	M.Tons
Alestes	2	Ø	35
Bagrus	1025	1141	1396
Barbus	182	183	199
Clarias	2507	1755	1729
Engraulicypris	5652	6704	8710
Haplochromis	6368	5378	6621
Labeo	123	939	148
Lates	97	203	1066
Mormyrus	89	102	132
Protopterus	935	773	612
Schilbe	57	129	120
Synodontis	191	310	155
Tilapia esculenta	49	42	180
Tilapia nilotica	421	465	972
Tilapia others	537	928	1454
Small mixed	445	280	327
Total	18680	19332	23856

CLASSIFICATION.

According to the available records and information it is known that 13 families and 29 general of fishes occur in Lake Victoria. Greenwood (1966) gave the number of families as 12 excluding the family centropomidae to which Lates nilotious the Nile Perch belongs. The largest number of species is found in the family Cichlidae containing 7 genera, the most important of which are Tilapia and Haplochromis. It is estimated that there are more than 200 species of fish in Lake Victoria with more than 100 species belonging to genus Haplochromis.

The fishes of Lake Victoria are listed here below (Table 4) according to families, genera and species and a local common name is given whenever known. The local names are derived from Greenwood (1966), Graham (1929) and from personal observation. However, as Semakula (1966) points out the local names may be erroneous or possibly not the commonly used name.

DISTRIBUTION.

The fishes of Lake Victoria are generally divided into 4 major groups according to their habitats. These are:-

(a) The deep water fishes which include Bargus-docmac, Mormyrus kanume and some species of Haplochromis. These are found in deep off-shore waters, but may also spread to the inshore areas.

(b) Anadromous species: Most of these fishes like Labeo victorianus and Barbus altianalis migrate to the affluent rivers during the rainy seasons to spawn

(c) The mud dwelling fishes composed of Protopterus aethiopicus and Clarias species. These fishes are capable of staying buried in the mud for long periods lasting up to several months.

(d) The riverine species which like Barbus amphigramma, Barbus apleurogramma and Hemihaplochromis multicolor are confined to rivers and streams.

Because of their importance in the Lake basin fisheries for many years in the past, the fishes found in rivers and streams formed the main basis for fish distribution studies around the lake. Most of the fishes in rivers and streams have been loosely classified by various scientists. Whitehead (1955) divided the fishes into 4 groups.

1. Those species like Tilapia esculenta and Protopterus aethiopicus which enter the rivers occasionally and only remain in the very lower reaches.

2. Fishes that enter the rivers regularly during the floods and remain in the courses of the rivers such as Barbus altianalis.

3. Fishes like Labeo victorianus which enter the river and soon pass out into waters to spawn.

Table 4. A list of the fishes of Lake Victoria

Family	Genus
Lepidosirenidae	Protopterus
Mormyridae	Mormyrus
	Petrocephalus
	Marcusenius
	Gnathonemus
Characidae	Alestes
Cyprinidae	Labeo
	Garra
	Engraulicypris
	Barbus

Species	Indigenous Local Name*	English
P. aethiopicus Heckel	Kamongo	Lung Fish
M. Macrocephalus Worthington	---	---
M. kanume Forskal	Suma	Elephant Snout
P. catostom (Gunther)	---	---
M. nigricans Boulenger	---	---
M. grahami Norman	---	---
G. Longibarbis Hilgendorf	Ondhuri	---
G. vitoriae Worthington	---	---
A. jacksonii Boulenger	Osoga	---
A. Sadleri Boulenger	Osoga	---
L. vitorianus Boulenger	Ningu	---
G. johnstonii (Boulenger)	---	---
E. argenteus (Fellegrin)	Omena	---
B. altianalis radcliffii Boulenger	Fwani	Barbel

(Table 4 Continued)

Family	Genus	Species
		B. amphdgramma Boulenger
		B. paludinosus Peters
		B. sexradiatus Boulenger
		B. neumayeri Fischer
		B. kerstenii Peters
		B. nyanzae Whitehead
		B. Jacksonii Gunther
		B. radiatus Peters
		B. magdalene Boulenger
		B. apleurogramma Boulenger
Bagridae	Bagrus	B. docmac Forskal
Schilbeidae	Schilbe	S. mystus (Linne)

Indigenous	Local Name*	English
Adel		---
Adel		---
---		---
---		---
---		---
(Adel)		---
---		---
---		---
Adei		---
Adel		---
Seu		Cat fish
Sire		Butter fish

(Table 4 Continued)

Family	Genus	Species
Claridae	Clarias	C. mossambicus Peters
		C. carsonii Boulenger
		C. Alluaudi Boulenger
	Clariallabes	C. petricola Greenwood
	Xenoclarias	X. holobranchus Greenwood
		X. eupogon (Norman)
Mochokidae	Synodontis	S. victoriae Boulenger
		S. afrofischeri Hilgendorf
Cyprinodontidae	Aplocheilichthys	A. pumilus (Boulenger)
		A. Eduardensis (David & Poll
	Cyropanchax	C. bukobanus Ahl
Centropomidae	Lates	L. niloticus (Linne)
Cichlidae	Tilapia	T. zilli (Gervais)
		T. nilotica (Linne)
		T. leucosticta Trewavas

Indigenous	Local Name*	English
Mumi		Mud fish
(Mumi or Ndhira)		---
Ndhira		---
---		---
---		---
---		---
Okoko		---
(Okoko)		---
---		---
---		---
---		---
Mbuta		Nile Perch
---		---
Nyamami		---
---		---

(Table 4 Continued)

Family	Genus
	Astatoreochromis
	Paralabidochromis
	Macropleurodus
	Hoplotilapia
	Platyaeniodus
	Haplochromis
Anabantidae	Ctenopoma
Mastacembelidae	Mastacembelus

Species	Indigenous	Local Name*	English
T. variabilis Boulenger	Mbiru	---	
T. esculenta Graham	Ngege	---	
T. melanopleura Dumeril	---	---	
A. alluaudi Fellegrin	---	---	
P. victoriae Greenwood	---	---	
M. bicolor (Boulenger)	---	---	
H. retrodens Hilgendorf	---	---	
P. degeni Boulenger	---	---	
(more than 60 species	Fulu	---	
C. muriei (Boulenger)	---	---	
M. frenatus Boulenger	Okunga	Spiny eel	

4. Those like the small Barbus species that permanently inhabit the rivers.

In the recent years a classification which covered a larger number of river fishes was made by Welcome (1963). He placed the small river fishes in three groups: Migrant species, riverine species and facultative species.

1. Migrant species were defined as those running into the river as sexually active fish, spawning at discrete sites and thereafter returning to the lake. These include:-

Barbus kerstemi.
Barbus pahidinosus.
Clarias carsoni.
Clarias alluadi.
Ctenopoma muriei.

2. Riverine species were those found associated with the river-swamp system at all stages of development like Hemihaplochromis multicolor.

3. Facultative species were identified as those found in alternative habitats in the lake and which have spread into the lower parts of the river systems, utilizing the increased area of swamp produced by rise in lake level during the rainly season. These include:

Aplocheilichthys pumulus
Astatoreochromis alluaudi.
Tilapia esculenta.
Tilapia leucosticta.
Tilapia niloticа.
Tilapia zillii.
Protopterus aethiopicus.
Some Haplochromis species.

A further classification of anadromous fishes based on the extent of up-river migrations was suggested by Cadwalladr (1965). He stated that some fish like Barbus altianalis migrate to the swift and rocky upper reaches of large rivers, while others like Labeo victorianus and Schilbe mystus migrate only short distances, passing out into flood water pools to spawn. The Alestes species especially A. jacksoni and Clarias mossambicus,

ascend small rivers in great numbers during the flood periods.

It has been observed from the fish landings around the Nyanza Gulf, however that there is no district barrier between the different habitats and many fish supposedly occupying isolated habitats may be found together in one fishing zone.

The trawl surveys conducted in the lake since 1968 has provided useful information about the distribution of the major species of fish in the lake. In their report, Marten et al (1975) divided the Kenya portion of the lake into 7 fishing zones. These were:-

I Areas with sandy, gravel or rocky bottom without substantial rivers or streams. Depth from 4 to 10 metres avaragely being 5 metres.

II. Soft muddy bottom. Substancial inflows from rivers. Bordered by flat land. Average depth 5 metres.

III. Depression in the Gulf formed by faulting/local subsidence. Very muddy bottom. Depth from 10-15 metres.

IV The mouth of the Gulf Rocky and/or gravel bottom. Depth about 15 metres.

V. The shallow area around Rusinga and Mfangano Islands. Sandy to muddy beaches. Depth, varying from 5 to 40 metres.

VI Exposed area of the lake extending from Rusinga Island to Port Victoria. Generally muddy. Depth 16-26 metres.

VII. Exposed southern section of the Lake extending from Rusinga Island to Karungu Bay and into the open waters. Bottom - of firm mud except in the sheltered bays of Kapsingri, Karungu and Mohuru where there is soft mud.

The average trawl catches from these areas were compared between 1969/70 and 1975. These are contained in the Tables 1 and 2.

ABUNDANCE:

According to the records of fish production up to 1960 the most important species of fish commercially were listed as Tilapia esculenta, Tilapia variabilis, Bagrus docmac, Barbus altianalis, Mormyrus kanume, Clarias mossambicus and Protopterus aethiopicus. These produced the largest catches then. The situation has changed in the recent years and some of these fish are now caught in small quantity only.

The results of the trawl survey conducted on the Lake between 1968 to 1972 indicated that the best catch rates in the Kenya portion in 1969/70 as shown in Table I came from Haplochromis species, Bargrus docmac, Clarias-mossambicus, Protopterus aethiopicus, Tilapia esculenta and Synodontis species. In 1975, however, the best production rates came from Haplochromis species, Bagrus docmac, Protopterus aethiopicus, Clarias mossambicus, Lates niloticus and Tilapia nilotica. (Table 2).

The fish production rates are also given in Table 3 which has been obtained from the statistics collected from the fishing landings at various beaches. According to these records the fishes which produced over 1000 metric tons in 1978 were Engraulicypris argenteus, Haplochromis species, Clarias species, mixed Tilapia species excluding Tilapia esculenta and Tilapia nilotica, Bagrus docmac, Lates niloticus and Tilapia nilotica the landing of which was 972 metric tons.

Observations from various beaches confirm that the greatest quantity of species landed every day are Haplochromis, followed in some beaches by Engraulicypris. The landings of Tilapia esculenta have continued to decrease rapidly as well as most of the anadromous species. There appeared to have been a sudden rise in Labeo production in 1977 however, the 1978 landing was once more at the low level of 148 metric tons. Two of the introduced species Lates niloticus and Tilapia nilotica have done well and now from part of the bulk of the large fish landings within the Gulf area.

STOCKING OF NON INDIGENOUS FISH:

Some of the fish in Lake Victoria did not exist naturally in the lake basin but have been artificially stocked from other lakes since 1931. These introduced fishes include 6 species of Tilapia; T. zillii, T. nilotica, T. T. leucosticta, T. melanopleura, T. nigra and T. mossambica and one species,

Table 3: Records of known stockings of Tilapia species and Lates niloticus into Lake Victoria or affluent waters.

Date	Place	Species	Numbers and Remarks	Authority
1931	L. Bunyoni	T. nigra	Stocked from L. Naivasha, Kenya and may have infiltrated into L. Victoria via tributaries of the Kagera. No. records from L. Victoria so survival doubtful.	U.G.D.*
1936	L. Bunyoni	T. nilotica	Stocked from L. Edward	U.G.D.
1951/53	L. Victoria	T. leucosticta	In April 1951 Kidetok Dam, Teso, stocked from L. Albert, thence other Uganda waters including Kajansi Fish Farm, Uganda and L. Victoria.	
1953	L. Victoria,	T. zillii	Over 14,000 from L.Albert stock (Originally 10 specimens) stocked by L.V.F.S. (December) from ponds at Kisumu.	L.V.F.S.
1953?	L. Victoria, Nyanza Gulf	T. leucosticta	Ponds at Kisumu stocked with the species.	L.V.F.S.
53/54	L. Victoria,	T. Melanopleura	Ponds at Kisumu stocked with the species.	L.V.F.S.
1954	Kagera River, Uganda	T. nilotica	Via Koki Lakes first stocked from L. Bunyoni in 1936. Capture from L. Victoria this year (1954).	L.V.F.S.
1954	L. Victoria Musoma and Mwanza Tanzania	T. zillii	200 in Capri Bay Mwanza; 50 in Mara Bay Musoma	L.V.F.S.
1955	L. Victoria Mara Bay, Musoma and Mwanza Entebbe, Uganda Nyanza Gulf and	T. leucostica and T. zillii	Approximately 12,000 into channel	L.V.F.S.

(Table 5: Continued)

Date	Place	Species
	Mfang'ano Island, Kenya	
1955	L. Victoria Entebbe (Harbor)	T. ziilii
56/57	L. Victoria Pilkington Bay	T. leucosticta
-	Buvuma, Entebbe	T. zillii
56/57	L. Victoria	T. nilotica
=		T. zillii T. leucosticta
1957	L. Victoria Kisumu, Kenya	T. nilotica
1958	L. Victoria Entebbe, Uganda	T. zillii T. leucosticta T. nilotica
61/62	L. Victoria Entebbe, Ugands	T. nilotica T. mossambica
Oct.'59	Luwala Dam, Uganda	L. niloticus
May '60	Uganda	L. niloticus
May'62	L. Victoria off-Entebbe pier	L. niloticus

Numbers and Remarks	Authority
128 (3-5cms) from Kajansi Fish Farm	U.G.D.
Large stocking by L.V.F.S.	L.V.F.S.
Approximately 1,500 stocked by L.V.F.S.	L.V.F.S.
Under 200 introduced here for first time in January.	L.V.F.S.
440	
490 All from Kajansi Fish Farm	L.V.F.S.
1,290	
1,474	
Used in ponds, dams and aquarial both in Kenya and Uganda in L. Victoria basin. No record.	Rhodes
Stocked with 18	EAFFRO
Caught at Bugungu above Rippon Falls and another at Waigali in Hannington Bay.	EAFFRO
35 stocked.	U.G.F.D.

(Table 5: Continued)

Date	Place	Species	Number and Remarks	Authority
Sept.'63	L. Victoria off Entebbe	L. niloticus	339 fingerlings stocked.	U.G.F.D.
1963	L. Victoria Kisumu	L. niloticus	8 stocked from Lake Rudolf	K.F.D.

*Abbreviations: L.V.F.S. - Lake Victoria Fisheries Service;
U.G.F.D. - Uganda Game and Fisheries Department.
U.G.D. - Uganda Game Department,
U.F.D. - Ugands Fisheries Department.
EAFFRO - East African Fresh water Fisheries Research Organization.
K.F.D. - Kenya Fisheries Department.

Source: From EAFFRO Annual Reports 1962 and 1963)

of Lates; L. niloticus (Nile perch). The records of T. nilotica, T. zillii and T. leucosticta indicate constantly increasing catches particularly in the inshore areas where most of the fishermen either set their gill-nets or operate the beach seines. The Nile perch has shown the greatest increase of all the introduced fishes. Lates niloticus of various sizes ranging from small juvenile fish to those weighting more than 50 kgm each are being landed regularly in many beaches.

Greenwood (1966) reported that Lates were present in the Lake Victoria basin during the Miocene period (about 25,000,000 years ago). In the Table 5 is given the record of known artificial stockings of Tilapia species and Lates niloticus into Lake Victoria or affluent waters. From the success of these artificial stockings it has been generally considered advisable to artificially raise some of the depleted stocks of indigenous fish especially Labeo, Barbus and some Tilapias along the lake shore or along some of the affluent rivers and restock the lake as appropriate.

CONCLUSION.

The Lake Victoria contains many types of fishes, some of which have only recently been introduced by artificial stocking. All the fishes in the lake are edible and include the major types such as Tilapia, Bagrus, Barbus, Clarias, Mormyrus, Protopterus, Haplochromis, Labeo and Engraulicypris Species and the Nile perch, Lates Niloticus.

The fishes are divided into two major groups, the Cichlid such as Tilapia and Haplochromis and the non-cichlid species. The fishes comprise more than 200 species belonging to 13 families which are further divided into 29 genera.

The Lake has been fished for centuries by the many indigenous fishermen, most of them fishing the limited easily accessible inshore areas and river basins. According to the landing returns for 1978 the species which contributed the greatest catch were Engraulicypris argenticus, Haplochromis species, Clarias species, Tilapia nilotica, Bargrus docmac and Lates niloticus. Some of the species, however, such as Tilapia esculenta and most of the anadromous species have shown sharp decline since 1960.

As a result of success shown by some of the artificially stocked non-indigenous fish suggestions have been made for artificial culture of the seriously depleted fish stocks with a view to restocking the lake.

REFERENCES.

Anderson, A.M. 1966. Further observation concerning the proposed introduction of Nile perch into Lake Victoria. East Africa Agric. For. J. 26(4) : 195-201.

Anonymous 1967. Lake Victoria fisheries research Fishing News International, London, Vol. 6 (5): p. 40.

Cadwalladr, D.A. 1965. The decline in the Labeo victorianus Blgr. (Pisces Cyprinidae) fishery of Lake Victoria and an associated deterioration in some indigenous fishing methods in the Nzoia River, Kenya. E. Afric. Agric. For. J. 30(3):249-256.

Corbet, P.S. 1966. Breeding sites of non-cichlid fishes in Lake Victoria. Nature 187 (4737: 616-617.

East African Freshwater. 1950-1974. Fisheries Research Organization Jinja, Uganda. Annual Reports.

Garrod, D.J. 1960. The fisheries of Lake Victoria, 1954-1959. East African Agric. J. 26(1): 42-48.

Graham, M. 1929. The Victoria Nyanza and its fisheries, Crown Agents, London, 255 pp.

Greenwood, P.H. 1966. The Fishes of Uganda, 2nd Edn. The Uganda Society, Kampala, Uganda, 131 pp.

Low-McConnell. 1975. Fish Communities in Tropical Freshwaters: Longman Group Limited. London. P. 126-138.

Marten G.G., Wanjala B. & Guhuka L.T. 1975. Report on Exploratory Trawling of the Lake Victoria Fishery in Kenya.

Pritchard, J.M. 1966. A geography of East Africa. Revised Ed. J.M. Dent & Sons Ltd. London 230 pp.

Semakula, S.N. 1966. Review of "The Fishes of Uganda; 2nd ed. by P.H. Greenwood. The Uganda J. 30(2): p. 236.

Welcome, R.L. 1963. The ecology of the fishes of a small river of the Lake Victoria basin. Appendix C. EAFFRO Annual Report 1962/1963. Government Printer, Nairobi, Kenya: 32-35.

Whitehead, P.J.P. 1955. Review of Kenya fisheries 1955. Government Printer, Nairobi, Kenya: 11-19.

PRODUCTION AND SOCIO-ECONOMIC ASPECTS OF FISHERIES IN THE LAKE VICTORIA BASIN (KENYA).

By

P.C. Kongere
Senior Fisheries Officer
Fisheries Department
Ministry of Tourism and Wildlife

1. INTRODUCTION

The Kenya Government has resolved to work for "alleviation of poverty" by focusing sharper attention on measures aimed at continued enhancement of growth, creating increased incomes and more employment opportunities, and increasing the output and quality of government services during the fourth development plan period (Development Plan 1979 - 1983). This resolve was repeatedly pronounced by President Moi during his visits to provinces immediately after his installation as the 2nd President of the Republic of Kenya. The objective was particularly underlined when Moi proclaimed the creation of the Lake Victoria Basin Development Authority (LVBDA) on the 16th December, 1978, the day he made his first Visit to Nyanza Province in his new capacity as President of the Republic of Kenya. Economic considerations must have been uppermost in the President's mind when pronouncing this proclamation. This was evidenced by the President's directive to the two Ministers responsible for economic matters in the country, the Vice-President and Minister for Finance, Mr. Mwai Kibaki, and the Minister for Economic Planning and Community Affairs, Dr. Robert Ouko to work out the details for the establishment of the proposed LVBDA.

The proposed establishment of the LVBDA is a recognition of the existence of closely linked economic niches in the Lake Victoria Basin (LVB) whose full potential may require identification and carefully co-ordinated development programmes for the benefit of Kenya in general and the LVB in particular. The LVBDA may, therefore, be expected to function as the primary government agency responsible for identifying and either undertaking or co-ordinating the desired development programmes in the LVB in the framework of the terms of its establishment and broad government policies.

The Lake Victoria Basin (LVB) may, for practical purposes, be defined as the region encompassing the whole of the catchment area of the expansive Lake Victoria. The definition goes beyond politico-administrative considerations and takes cognizance of the importance of water resources in the economic development of the LVB. Lake Victoria is trinational, being shared by Tanzania, Uganda and Kenya. This implies that the LVB stretches beyond the Kenya boundaries into Uganda and Tanzania. Only the Kenya part of the LVB has been discussed in details in this paper in recognition of the politico-administrative delimitations. This has been taken in the context of fish production and the role of fisheries in the economic development of the Kenya side of LVB.

Fisheries represent only one of the many uses derivable from water which include transport, power generation, recreation, wastes disposal e.t.c. The use of water for fish production may either conflict with or enhance its use for these other purposes. It is quite common to dispose of raw or treated sewage from urban centres into aquatic media. In such cases the water reservoirs act as useful receptacles of the unwanted sewage. However, in high quantities or when carrying certain harmful chemical compounds, sewage could inflict severe pollution in the receiving aquatic medium making the reservoir unsuitable for fish production. On the other hand, the stocking of Lake Naivasha with the exotic blackbass has considerably increased the recreation utility of the Lake. People can now go to Lake Naivasha for boating as well as fishing for sport. It is consequently absolutely necessary to fully understand the inter-relationships of the various uses of water, with respect to a particular aquatic medium, in order to be able to make a rational choice between policy options.

Policy options within the fisheries sector itself are fundamental issues in the development of fisheries resources. There are a number of objectives towards which a fishery policy may be directed. These may include the production of fish for domestic consumption or export, socio-economic reasons such as employment, etc. These objectives may mutually be either incompatible or compatible and their reconciliation is important in the development of a fishery. An awareness of the effect of alternative lines of action relating to fisheries development strategies would, therefore, be a useful basis for policy formulation.

In this paper the various aspects of the fishing industry in the LVB are explored with in-depth analyses of trends in fish production and management, the sociological background of the fishermen, marketing systems and employment opportunities. In covering this wide field attempts are made to identify areas in which the various government institutions and agencies can help promote the rational management and development of the fishing industry in the LVB.

II FISH PRODUCTION

1. Introduction

The trends in fish production in the LVB has been an area of great interest to fisheries scientists, economists as well as concerned members of the public. Much interest has particularly been shown on the varying patterns of production of the major fish groups in the Kenya waters of Lake Victoria. This part of the expansive lake Victoria is the primary source and account for over 97% of all the fish produced in the Kenya part of the lake basin. Less interest has been shown on the various rivers that empty into the lake such as Kuja, Sondu, Nyando, Yala, Nzoia etc. However, the rivers remain important sources and provide appropriate conditions for part or whole of the life cycles of the "anadromaus" fish species in the Lake Victoria basin such as Labeo (ningu), Barbus (fuani-odhadho) etc. The other important source of fish in the LVB but whose potential has not been fully explored is aquaculture. Some artisanal fish culture has been going on for many years in most of the areas in the LVB providing invaluable protein food for the people.

The trinational Lake Victoria has a tropical luxuriance which apparently gives it the multispecies fishery. There are well over 170 species of fish in the lake dominated by two cichlids, Tilapia (ngege) and Haplochromis (fulu), and one cyprinid, Engraulicypris argenteus (omena). The other important fish groups in the lake include Clarias (catfish-mumi), Protopterus (Lungfish-Kamongo), Bagrus (Otik seu), Schilbe (sire), Synodontis (Okoko), Alestes (Osoga), Lates (Mbuta - Nile Perch), Mormyrus. (Snoutfish) etc. There are also the "anadromous" cyprinids such as Barbus (Fuani-odhadho), Labeo (ningu) etc., which form important lacustrine and riverine fisheries in the region.

The great majority of the fish species with the exception of Haplochromis, and to some extent Synodontis, Clarias and Bagrus, are found in the in-shore waters of Lake Victoria not deeper than 20M. However, it is known that considerable quantities of the off-shore Haplochromis remain unexploited while the great majority of the in-shore fishes give some impression of decline in abundance. On the whole it is estimated that the potential, maximum, sustainable yield from the Kenya waters of Lake Victoria is about 30 thousand tonnes per annum. However, according to Fisheries Department statistics sources the highest fish production from the Kenya waters of Lake Victoria was realized in 1977 when 19,332 tonnes was landed. This suggests ample scope for further increase in fish production from the Kenya waters of Lake Victoria before achieving the maximum sustainable yield.

2. Lake Victoria

Lake Victoria remains the single most important fisheries in Kenya today. The Kenyan part of the lake, which has a surface area of 3,755 km^2 km^2 (less than 10% of the total lake surface area of approximately, 68,000 km^2(, has for many years accounted for over half of the total domestic fish production in the country (Fisheries Department statistics sources). Out of the average total catch of 34,476 tonnes per year during the period 1974 through 1977 the Kenyan part of Lake Victoria accounted for an average of 17,942 tonnes per years. During the same period, Lake Turkana, which is the largest freshwater body in Kenya with a surface area of 6,405 km^2, accounted for an average of 10,621 tonnes of fish per year while the marine landings accounted for an average of only 4,108 tonnes per annum.

The relatively high rate of fish production recorded for the Kenyan part of Lake Victoria could be a reflection of its greater biological productivity compared to other areas of the lake and also to other aquatic media in Kenya. It is calculated from statistical records that the Kenyan part of Lake Victoria produces an average of 4.78 tonnes of fish per km^2 per year compared to 2.63 tonnes per km^2 per year from the Tanzanian and Ugandan parts of the lake put together for the period 1974 through 1977. We also get average production rates of the order of about 1.65 tonnes per km^2 per year from Lake Turkana and about 0.53 tonnes per km^2 per year from the Kenya waters of the Indian Ocean during the same period.

Table 1. Total Annual Production and Value of Fish Caught in the Kenya Waters of Lake Victoria in the Period 1968 Through 1977.

Years	Annual Production in Tonnes	Value in K. Shillings
1968	16,357	15,167,000
1969	17,442	16,047,000
1970	16,400	15,482,000
1971	14,918	15,383,000
1972	15,980	16,825,000
1973	16,797	18,127,000
1974	17,175	21,007,000
1975	16,581	21,308,000
1976	18,680	24,050,000
1977	19,332	25,681,000

The Winam Gulf is the shallowest and is also the major portion of the Kenyan part of Lake Victoria. Marten, Wanjala and Guluka (1975) report that the depth range in the gulf lies between 4M. and 15M. with only afew areas reaching depths of about 20 Metres. Most of the open parts of the lake, however, lie between 30M. and 60M. with the deepest areas reaching about 79M. The shallowness of the gulf may account for its relatively higher productivity compared to the rest and deeper parts of the Lake. The rich bottom nutrients can easily be brought to surface waters, by strong wave activity, where they would fertilize primary productivity, Algal blooms are a common feature in the Winam Gulf during the long rains, which season is also associated with strong winds.

However, as will be noted elsewhere in this paper, the relatively high rate of fish production from the Kenyan part of Lake Victoria could also be a reflection of the extremely high fishing pressure which the Lake may have been subjected to in the recent few years.

Trends in Fish Production. Fish production is governed by many aquatic, environmental and management factors. It is usually a fairly delicate process trying to harmonize these factors to ascertain the optimal exploitation of a fishery. This has been the case with Lake Victoria fisheries where production over the period of recent memory have been rather erratic. The varying trends in fish production have caused many people to speak and write, especially in the last fifty years or so, about an overfishing problem in Lake Victoria (EAFERO Reports 1951-1977; Heimo Mikkola, 1977, Oyugi Aseto, 1979). Some of the pronouncements may have been justified. However, many people have written and spoken without attempting to understand the Lake Victoria fisheries and/or offering any suitable, alternative methods for the better management, exploitation and sustainance of the numerous fisheries in the lake.

The best method of understanding the potential of a fishery is to undertake a careful statistical analysis of the catches. I have here below used the statistics records obtained from the Fisheries Department to analyse the trends in fish production from the Kenya waters of Lake Victoria during the ten year period 1968 through 1977. The length of time for this analysis was selected to provide ample perspective of the past state and patterns of the fishery and to enable more justifiable discussion of the desired future trends in production. It should be emphasized that the Fisheries Department used almost the same techniques in collecting and processing the statistics data used in these analyses thereby eliminating

any variations which might be attributed to changed methods in the compilation of statistical records.

Total Annual Fish Catches

The total annual catches in tonnes from the Kenya waters of Lake Victoria during the period 1968 through 1977 are given in Table 1 and Figure 1. The catches increased from 16,357 tonnes in 1968 to 17,442 tonnes in 1969 but thereafter decreased to an all time low of 14,914 tonnes in 1971, a decrease of 14.49% below the 1969 catch. There was thereafter a gradual increase in annual production, but the 1969 record remained unsurpassed until 1976 when 18,689 tonnes was recorded. This marked an increase of 7% over the 1969 catch. In 1977 there was the highest increase ever with a catch of 19,332 tonnes, giving a rise of 10.83% over the 1969 record.

The impression one gets from the analysis above is that while the Lake Victoria fisheries initially declined to the fairly low level recorded in 1971, it managed to pick up thereafter and showed a certain upward trend towards the end of the review period. Probably a more realistic picture of the potential production trend of the fisheries would have been obtained if an element of the "Catch per Unit of Effort" involved were examined. "Catch" is the amount/quantity of fish caught. "Unit-Effort" may be defined as the standard quantity of fishing pressure applied to a fishery. A unit of effort may be worked out in terms of a single gill net of standard dimensions', a number of standard gill nets per canoe, period of fishing with standard gear, etc. I have not attempted to work out the average catch per boat from the available statistics data as the results would have not been any different. Moreover, the Statistics Section in the Fisheries Department used the same conversion factors, during the period under review, in expanding their statistical data without allowing for the inevitable seasonal and/or annual variations in fishing effort.

Powell (1977), however, attempted an analysis of the data collected on successful canoe landing for the nine-year period, 1968 through 1976. A successful canoe may be defined as a canoe landing a minimum of one fish. He selected eight landing beaches distributed evenly along the entire length of the shores of Kenya waters of Lake Victoria. He observed that there was a gradual decrease in the number of successful canoe landing at each of the beaches, indicating declining fisheries. He recorded the highest landing of 112,896 for 1968 and the lowest of 57,872 for 1975 or a decrease of 49%. Although he recorded an increase of 28% between 1975 and 1976 he noted

Table 2. Annual Catches in Lake Victoria Tonnes

Years	Engraulicypris	Haplochromis	Bagrus	Clarias	Protopterus	Tilapia	Labeo	Lates
1968	732	3743	1147	1737	2802	2419	595	-
1969	520	6427	966	1326	1626	4645	467	17
1970	524	5357	1091	1592	1629	4510	296	28
1971	759	4762	1056	1862	1798	3142	228	46
1972	1255	4644	856	2725	1915	2369	310	38
1973	1768	5571	1445	2628	2024	1690	141	147
1974	3742	6013	1103	2211	2179	956	59	89
1975	4548	4620	1389	2584	1469	642	108	51
1976	5652	6368	1025	2507	935	1007	124	97
1977	6704	5378	1141	1755	773	1435	939	203

Table 3. Percentage Contribution on the Various Species to the Total Annual Fish Catches in the Kenya Waters of Lake Victoria

Species	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Engraulicyoris	4.47%	2.98	3.20	5.09	7.85	10.53	21.79	27.43	30.26	34.68
Haplochromis	22.88	36.85	32.66	31.91	29.04	33.16	35.01	27.86	34.09	27.82
Bagrus	7.01	5.54	1.29	7.08	5.35	8.60	6.42	8.38	5.49	5.90
Clarias	10.62	7.60	9.71	12.48	17.04	15.65	12.87	15.58	13.42	9.08
Protopterus	17.17	9.32	9.93	12.05	11.98	12.05	12.69	8.86	5.38	3.99
Tilapia	1.25	26.63	27.50	21.07	14.82	10.07	5.30	3.87	5.38	7.42
Labeo	3.64	2.68	1.80	1.52	1.94	0.84	0.34	0.65	0.66	4.86
Lates	-	0.10	0.17	0.31	0.24	0.87	0.79	0.31	0.52	1.05

that there was a general decrease of 34% in the period 1968 through 1976, representing a loss of 40,000 landings with respect to the eight landing beaches. To some extent, Powell's analysis tends to agree with my analysis above based purely on the total fish catches from the Kenya waters of Lake Victoria during the same period, 1968 through 1976. Powell's findings could also imply that there had been a considerable increase in the number of fishing canoes operating and chasing a constant quantity of fish stock in the Kenya Waters of Lake Victoria during the period 1968 through 1976.

Fish Groups of Economic Importance. The fisheries of Lake Victoria is composed of well over 170 species all of which are of value, in one way or another, to fishermen and consumers alike. These can be further reduced to 15 broad groups of fish species. Fish production from the Kenya waters of Lake Victoria during the period 1968 through 1977 displayed considerable variation with changes peculiar to each of the 15 fish groups. The changes in production rates displayed by each of the 15 fish groups also had considerable bearing on the overall trend in the fisheries of the Kenya waters of Lake Victoria.

In order to be able to evaluate the impact of the changes in the fisheries patterns of the various fish groups on the overall fish production trend in the Kenya waters of Lake Victoria I have here below attempted an in-depth analysis of the catches of the various fish groups and species over the period 1968 through 1977. Of the 15 groups of fish species that are normally recorded at the landing beaches only eight were selected for this in-depth analysis. The eight, species or fish groups currently represent over 95% of the total catches from the Kenya Waters of Lake Victoria. They include Tilapia species, Haplochromis species, Bagrus domac, Clarias Moassambicus, Engraulicypris argenteus, Protopterus aethiopicus, Lates niloticus and Labeo victorianus. The total annual catches of each of the above fish groups are outlined in Table 2 and Figures 2 through 9. The percentage contribution of each of the eight fish groups to the total annual catches during the review period are also presented in Table 3 and Figure 10.

Tilapia Species (Ngege). This group of fish is considered to be the most important of all the freshwater fishes in Kenya. This has caused it to be hotly hunted for and subjected to extremely intensive fishing pressure wherever it may have been found in the wild in Kenya. The exploitation of the Tilapia fishery has particicularly been most severe in the Kenya waters of Lake Victoria.

Mention has been made earlier in this paper of the regular references to the overfishing problem in the Kenya waters of Lake Victoria. Initially all the references were to the one preferred species, Tilapia esculenta. Of late, however, this has been extended to cover all species of Tilapia. In recent times the apparent decline in Tilapia fishery in the Kenya waters of Lake Victoria has mostly been attributed to the predatory behaviour of Lates niloticus (Mbuta). This may not be true as there is as yet no convincing evidence in support of the claim. The subject will, however, be discussed in more details in later parts of this paper.

It is quite true that the production of Tilapia species from the Kenya waters of Lake Victoria has gone through a gradual reduction over the recent few years. Table 2 and Figure 2 clearly show that from the high catch of 4,645 tonnes in 1969, there was a gradual decline to the lowest level of 642 tonnes in 1975. The catches slightly picked up thereafter to the highest landing in recent times of 1,435 tonnes recorded in 1977. Table 3 and Figure 10 also indicate that the percentage contribution of Tilapia to the total catch of all the fish species in the Kenya waters of Lake Victoria has shown a declining trend, especially from 1969 becoming almost an insignificant fishery in 1975. The slight increase shown in the period 1975 to 1977 may be attributed to the increasing success of Tilapia nilotica (Nyamani) (currently Sarotherodon niloticus) fishery . Tilapia nilotica is exotic to Lake Victoria and, like Lates niloticus (Mbuta) was introduced into the lake in the 1950's. It took time to establish itself but is now increasingly becoming the predominant Tilapia species.

Fisheries scientists have offered various explanations for the decline in the Tilapia fishery in the Kenya waters of Lake Victoria. First, they explain that the Tilapia population has been adversely affected by the fairly intensive fishing pressure which they have been subjected to in the last few years. It is true that increasingly many beach seines have been licenced for use along the open beaches of the Kenya waters of Lake Victoria in the last few years. Such areas are usually inhabited by the juveniles and immature stages of Tilapia species, especially T. zillii and T. variabilis. Wanjala (1974) reports that these species have most adversely been affected by beach seines. He also reports that several immature Tilapia esculentaare usually caught in beach seines. The considerable rise in Lake Victoria water levels in the period 1961 through 1964 was also thought to have caused the decline in Tilapia fishery.

Wellcome (1969) explained that the rise in water levels submerged and destroyed the nursery grounds of most of the Tilapia species. He argued that the rise in water levels made many of the places too deep for the fry and other sites to become choked with thick emergent vegetation. He felt that Tilapia esculenta which inhabits lagoons and prefers sheltered swampy margins for nursery grounds must have been hit hardest by the rise in lake levels.

Engraulicypris argenteus (Omena). This species was an insignificant fishery until the late 1960's when it began to appear prominently in the reported catches from the Kenya waters of Lake Victoria. Table 2 and Figure 4 clearly show that Engraulicypris landings increased significantly from the low catch of 520 tonnes in 1969 to the all time high of 6,704 tonnes in 1977. This increase was considered phenomenal making Engraulicypris the largest single species landed from the Kenya waters of Lake Victoria. This has further been verified in Table 3 and Figure 10 which show that by percentage composition of the total catch from the Kenya waters of Lake Victoria Engraulicypris has increased from the low figure of 2.98% in 1969 to the all time high level of 34.68% in 1977. This phenomenal increase in Engraulicypris catches can be attributed primary to improved fishing techniques in the last ten years.

This species is mainly captured through the use of registered mosquito seines and employing light attraction techniques. At present it appears there is plenty of scope for increasing the production of this group of fish. Although the exact potential is not known, it has been reported by fishermen and fisheries field staff that this species is landed in much larger quantities in the Winam Gulf than in the open waters of Lake Victoria.

Haplochromis species (Fulu). Haplochromis has remained an important fishery in the Kenya waters of Lake Victoria for many years. The catches of the group during the period 1968 through 1977 give no detectable trend with landings remaining between just below 4,000 tonnes and slightly above, 6,000 tonnes (Table 2 and Figure 3). The percentage contribution of this group of fish to the total catch of all species in the period varied between 22.88% and 35.01% again with no detectable trend (Table 3 and Figure 10). Wanjala (persn. Comm.) felt that there may be a five-year cycle in Haplochromis productivity. This is, however, not apparent in Figure 3. Moreover Wanjala has not advanced any evidence to verify the claim.

It has been observed by fishermen and various fisheries officers that larger sized species of Haplochromis have considerably declined in the last few years. Wanjala (1974) reported that it was apparent the maximum length of Haplochromis had declined from 14cm and 16cm. to 12cm. with large numbers down to 6cm. It is felt that this could have been caused by overfishing with persistent use of small meshed gill nets. Haplochromis is mainly exploited by gill nets of the size $1\frac{1}{2}$" to $1\frac{7}{8}$" and $2\frac{1}{2}$". The decline in the larger sizes of Haplochromis may also be attributed to the predation of Lates niloticus. Nile Perch prefers Haplochromis for food (Gee, 1969). It should be pointed out, though, that the taxonomy and biology of many of the Lake Victoria Haplochromis is still largely unknown which makes the management of the numerous different species (over 90 species) most difficult.

During the UNDP FAO trawling survey conducted in Lake Victoria in 1969-70 it was estimated that the annual sustainable yield of Haplochromis in the whole of the Lake was of the order of 200,000 tonnes. Although this estimate is for the whole of the lake and has been a subject of great scientific controversy it gives some indication of what would be the possible potential of Haplochromis fishery in the highly productive Kenya waters of Lake Victoria.

Bagrus docmac (Otik sp.). This species is caught by all sizes of gill nets used in Lake Victoria. Its catch statistics have remained rather steady. Over the period under review (1968 - 1977), varying only slighly between 966 tonnes in 1969 and 1445 tonnes in 1973 (Table 2 and Figure 6). The percentage contribution of the species to the total catch of all species also appears to have remained rather steady, varying between 5% and 8%. It was only in 1970 when the lowest percentage of 1.29 was recorded. What these data imply is that the Bagrus catch must have tended to decrease and increase proportionately with the total catch in the Kenya waters of Lake Victoria during the period reviewed.

Clarias mossambicus (Cat fish - "Mumi"). This species is primarily caught with hooks and line as well as gill nets down to $2\frac{1}{2}$ inches. Total catches appear to have considerably varied over the period 1968 through 1977, recording the lowest catch of 1,326 tonnes in 1969 and the highest of 2,725 tonnes in 1972. Thereafter the catches fell gradually to 1,755 tonnes in 1977 (Table 2 and Figure 5). It appears that as the total catches of most other species declined during the review period, the percentage contributed by Clarias slightly increased (Table 3 and Figure 10). Powell (1977) had, however, failed to prove in a statistical analysis that Clarias catches had

had actually been declining in nearly all the landing beaches along the inshore areas and increasing in the open waters on the Kenya part of Lake Victoria. Unfortunately, he could not offer any explanation for his derived anomaly. However, Clarias is an off-shore fish and is expected to be more abundant in the deeper than in the shallower zones of the lake.

Protopterus aethiopicus. (Lungfish - Kamongo). This species is caught in all the gill nets from $2\frac{1}{2}$ in. to 6 in. as well as by hook and line and spear hunting. Total catch of this species greatly declined in the period 1968 through 1977. The fishery picked up from the low landing of 1,625 tonnes in 1969 and increased to 2,179 tonnes in 1974 before crashing to the all time low catch of 773 tonnes in 1977 (Table 2 and Figure 7). The percentage this species contributed to the total catch in the same period remained somehow high upto 1974 after which it gradually decreased to 3.99% in 1977. (Table 3 and Figure 10).

Lates niloticus (Nile Perch - Mbuta). Lates niloticus are endemic to only two East African lakes, Lake Albert and Lake Turkana. In order to try to assess the effect of an introduction of Lates into a cichlid dominated fauna, a pilot introduction was made in Lake Kyoga and a number of smaller lakes and dams in Uganda in 1955. Lates managed to establish itself and form an important element of the commercial catches in Lake Kyoga. In 1960 Lates first accidentally gained access to and were later deliberately introduced into Lake Victoria (Gee, 1969) and is now increasingly becoming an important fishery in the lake. From the near zero catch in 1968 the Nile Perch fishery has steadly increased in the Kenya waters of Lake Victoria. A record catch of 203 tonnes was recorded in 1977 (Table 2 and Figure 8). The percentage contribution of Nile Perch to the total catch of all species has similarly, gradually increased from nearly zero in 1968 to 1.05% in 1977 (Table 3 and Figure 10). This trend seems to imply that Lates fishery may be here to stay and could continue to increase and even more sharply in the next few years. There are also possibilities that Lates may eventually be established as the major fishery in the Lake Victoria provided the resource is carefully monitored and managed. Lates is caught in highphy gill nets of 5 in. mesh sizes and above. For sporting purposes hook and line may also be used. It is an inshore fish and may also be taken in beach seines.

Much controversy has developed in the recent years over the possible role of Lates niloticus in the changing trends in the fisheries of Lake Victoria. Some people have attributed the apparent decline in some of the lake fisheries, especially that of Tilapia, to the predatory activity of Nile Perch in the lake (Oyugi Aseto, 1979). In most of the cases the people have ignored the successful Lates fishery in lakes such as Turkana and Albert where the supposed monster has co-existed with Tilapia for hundreds of years without affecting the Tilapia fishery. What is more interesting is that some of the people who speak and write so negatively about the Lates fishery in Lake Victoria are the very people who trek to the remote Lake Turkana in search of Lates catches for business. Lates admitedly is a predator and will certainly feed on most of the fish species found in Lake Victoria including their own young ones. Like most other animals, though, Lates will have its preferred food. What is certain is that the preferred food is not Tilapia. Moreover there is no convincing evidence to support the claim that the presence of Lates may be affecting the Tilapia stocks in Lake Victoria.

Gee (1969) examined the stomach contents of Lates from Lakes Victoria, Kyoga and Albert to try to establish any possible predation pressure that this fish species may have on any other fauna in the various lakes. His results are reproduced in Table 4. What should be most obvious from these results is that while Lates do not feed specifically on any one species or group of fish, Haplochromis form the main component of their diet, followed by Mormyridae. Gee goes on to explain that this trend in food composition appears to remain the same irrespective of the size of Lates. Ogari (Pers. Comm.) who is currently working on the Lake Victoria Lates tends to agree with Gee.

On the whole Lates is a most invaluable fish. If the Tilapia fishery in Lake Victoria is not seriously affected but large quantities of the Haplochromis small mormyrids, Engraulicypris and Alestes are utilized, as was established by Gee (1969), even though the conversion rate may be inefficient, these "trash" fishes would be converted into fish flesh both more palatable and universally marketable representing a gain in the present fishery. Lates offers a larger amount of flesh per unit weight than even the preferred Tilapia. Moreover, Lates is most popular with sport fishermen, offering possibilities of extending tourism to Western Kenya. One Lates weighing nearly 200 kg was landed off Uyoma in 1978 (The Standard, Kenya, 15.78). The Lates fishery in the Lake

Table 4. Feeding Habits of Lates Niloticus

	L. Victoria		L. Kyoga		L. Albert	
	No. of Prey	No. of Fish in which prey occurred	No. of Prey	No. of Fish in which prey occurred	No. of Prey	No. of Fish in which prey occurred
Unidentified Fish	-	37	-	17	-	8
Morymridae (unidentif.)	21	16	-	-	-	-
Marcusenius nigricans	6	3	-	-	-	-
Marcusenius grahami	7	4	-	-	-	-
Alestes Jacksoni	6	5	-	-	-	-
Alestes baremose	-	-	-	-	6	4
Engraulycypris	13	11	-	-	3	3
Barbus sp.	6	3	-	-	-	-
Clarias sp.	1	1	2	2	1	-
Lates niloticus	-	-	1	1	-	-
Cichlidae (unidentified)	44	20	1	1	10	1
Tilapia sp.	23	12	29	14	1	1
Haplochromis sp.	119	49	181	31	1	1
Caridina nilotica	-	-	-	-	many	8
Insects	-	2	-	2	-	-
Odonana nymphs	-	-	13	5	3	2
Bivalve molluscs	1	1	-	-	2	1
Gastropod Molluscs	-	-	2	2	-	-
Chironomid laevae	1	1	-	-	-	-
Plant remains	-	-	-	3	-	-

Note: Adopted from Gee (1969) on "A comparison of certain Aspects of the Biology of Lates niloticus (Linne) in Endemic and Introduced Environment in East Africa"; published in Man-Made Lates: The Accra Symposium; Ed. L.E. Obeng.

Victoria is, therefore, likely to be of multi-socio-economic value in the long run than may presently be apparent.

Labeo victorianus (Ningu). This species had decreased in importance over the years despite the great preference by the consumers, especially those around the lake. They are usually caught in 1½" to 1¾", 2½" gill nets and traps laid across river courses. The population has largely been overfished with the catch reducing from 595 tonnes in 1968 to the all time low catch of 59 tonnes in 1973. (Table 2 and Figure 9) The recent trend showing an increase in Labeo catches can be attributed to the low fishing pressure which it has been subject to lately. In a way people may have given up fishing specifically for Labeo because they had virtually disappeared, especially about 1974/75 period. The percentage contribution of Labeo to the total catch has behaved in a similar way recording an all time low of 0.34% in 1974 and a high percentage of 4.86 in 1977. The Labeo population can only be expected to recover appreciably if fewer Haplochromis gill nets and river traps remain in use.

Other Fish Groups. The other fish groups that together account for about 4% of the fish landings from the Kenya waters of Lake Victoria include Barbus (Duani-Odhadho), Mormyrids (Suma) Schilbe (Sire) Synodontis, (Okoko), Alestes Alestes (Osoga) etc. Among these the riverine Barbus species used to be most important and popular with consumers. Barbus remains the most luxurious fish from Lake Victoria although it has mostly been over-fished and become very rare. Like Labeo, Barbus fishery may only be able to pick up in the long run if trapping along the river courses is prohibited.

THE OVERALL PATTERN OF LAKE VICTORIA FISHERIES

The overall picture one gets from the in-depth analyses above is that during the ten-year period, 1968 through 1977, there was considerable variation in fish production from the Kenya waters of Lake Victoria caused by individual changes in the fisheries trends of the major fish groups found in the area. Total fish production declined initially to the lowest levels in the 1973-74 period when after it began to pick up once again. By the end of 1977 it was felt that the fisheries of the Kenya waters of Lake Victoria had satisfactorily assumed an upward trend, moving towards the estimated optimum sustainable yield. It has been mentioned earlier that the Kenya waters of Lake Victoria is expected to be able to sustain an optimum yield of 30,000 tonnes of fish per annum. What was significant by the end of 1977, though, was that the dominant fish groups had somehow changed during the ten-year period (1968-1977).

Prior to 1968 Tilapia species had been the most important and dominant fishery in the Kenya waters of Lake Victoria (Fisheries Department Statistics Reports). This fishery declined over the years and by the end of 1977, although showing signs of possible recovery, it had effectively been relegated to a much lower status than even some of the hitherto unimportant fisheries. The place of Tilapia had effectively been taken by Engraulicypris which today remains by far the most dominant fishery in the Kenya waters of Lake Victoria. Protopterus which, like Tilapia, had been an important fishery in the 1960's and is even today considered a delicacy, especially by those around the lake, also showed drastic reduction with no signs of picking up. Haplochromis withstood the test of time and managed to remain steady and dominant over the period, although Powell (1977) claimed that it had also started to display signs of potential decline. Bagrus and Clarias also managed to remain somehow steady in production over the period reviewed. The most remarkable development is the still insignificant but somewhat determined upward trend shown by the exotic Lates niloticus.

One further interesting observation is that, as at the end of 1977, the fisheries of the Kenya waters of Lake Victoria was dominated by the small sized species, Engraulicypris and Haplochromis. These two groups are less popular and more difficult to market to any other communities than those coming from around the lake region. This together with the theoretical difference between the potential and the realized production should provide a basis for determining those exploitation and management measures necessary not only for bringing about appropriate changes in the fishery patterns in the lake, but also for increasing fish production.

3. FISH FARMING

General. The development of the rural economy in order to provide more food, employment, income and, consequently, help raise the standard of living of people in the rural areas has been an important aspect of the philosophy underlining the economic development strategy in Kenya since the country gained independence (1963). Fish farming is one of those areas for which there is substantial potential worthy of greater development in the rural Kenya. In recognition of this, the Kenya Government has decided to accord fish farming development the emphasis and priority it deserves during the current five year Development Plan.

Fish culture may be defined as the rational rearing of fish in artificial conditions and involves the regulation of fish growth and breeding. Fish culture may facilitate the development of land which otherwise would have remained unproductive, either because of too much water, or simply dry. It may also enable the artificial re-stocking of those reservoirs that have been depleted due to overfishing, pollution and other works carried in the water medium.

The primary objective in fish farming is the production of additional animal protein food for improvement of the subsistence diet of the local population. Fish farming may, however, also be undertaken as a profit generating business aimed at providing employment and additional income to the rural population. Furthermore, fish culture involving the restocking of water media may be for economic and recreation purposes. It would be economic when undertaken to improve the return on commercial fishing. However, it would be recreational when intended to increase fish population for sporting purposes.

Fish culture for food has hitherto mainly been undertaken at artisanal subsistance level in Kenya. This involves families having one or two ponds mainly for the provision of occasional needs. The few extra fish obtained may be sold to provide some little extra income for the family. There are, however, some few fully or semi-commercial fish farms in Kenya. In pursuance of the pronouncements in the fourth Development Plan (1979-1983), the Kenya fisheries authorities are already paying increased attention and are striving to uplift fish farming in most parts of Kenya to fully or semi-commercial status.

Fish culture has mostly been encouraged and undertaken in those areas of Kenya that are rather distant from the natural sources of fish but which possess the requisite conditions for aquaculture development. The most important fish farming areas in Kenya have, therefore, hitherto included Central, Eastern, parts of Nyanza, Western and Rift Valley Provinces. Mariculture work was also recently initiated in the Coast Province.

Fish Farming in the Lake Basin

It is noteworthy that nearly all areas definable as constituting the Kenya part of the Lake Victoria Basin have featured fairly well in fish farming development. Western, Nyanza and Rift Valley Provinces have all been active fish farming areas in the last two decades. Inspite

of this long period of activity fish farming for food remains at artisanal level in the whole region. This has probably been due to the fact that the region has all the while been well catered for and adequately supplied with fish from the expansive Lake Victoria. It would, however, also be due to the lack of trained manpower and, therefore, inavailability of expertise for the development of fish culture in the region. It is, however, known that most of the Lake Victoria Basin has great potential for fish farming development.

The region has many rivers with adequate and suitable water supply which is a fundamental prerequisite for fish culture development. Climate regimes also provide ideal situations for both warm water and cold water aquaculture development. What is more there is plenty of land in the region that could be used for fish culture. It should be pointed out further that there is considerable scope for undertaking fish culture even in the waters of Lake Victoria itself.

There is a paucity of information on the production of fish from fish farming sources in Kenya. From Fisheries Department Statistics records for 1977 it was reported for instance that:

> The output of 547 tones is only from the ponds surveyed by Departmental Staff while many ponds are yet to be covered.

There is not much information either on the exact area under fish ponds in the various regions. Such information together with others such as area of each pond, average production of ponds sampled etc., would be vital for the realistic estimation of production from fish farming sources.

It is estimated that there are currently a total of about 5,000 fish ponds in the Lake Victoria Basin. (Fisheries Department Statistics and Annual Reports Sources; Personal Communication with various field Fisheries Officers). Most are reported to be small family ponds of about 0.25 acre in average surface area. Breakdown of number of fish ponds per district are provided in Table 5. Most of the ponds are estimated to give average output of about 0.5 - 1.5 tonnes per hectare per year depending on standard of husbandry. I wish to emphasize that it is possible to get a production greater than 3 tonnes per hectare per annum with extensive farming techniques.

The fish farmers mainly use Tilapia which is capable of growing to market size, of about 300-500gm in 5 to 8 months. On the basis of these data it is estimated that the potential total fish production from aquaculture sources in the Lake Victoria Basin is currently of the order of 500 to 1500

Table 5: The Number of Fish Ponds, Dams and Fish Farmers in the LVB

District	No. of Fish Pnds	No. of Dams	No. of Fish Farmers
Kisii	1261	12	410
South Nyanza	415	28	
Siaya	270	53	
Kisumu	10	-	6
Kericho	-	3	-
Bungoma	664	36	486
Kakamega	1705	18	1433
Busia	427	9	330
Nandi	-	-	-

tonnes per year.

In addition to the small family fish ponds there are many public and private man-made dams distributed all over the Lake Victoria Basin most of which have been stocked with various fish species. The dams range from a few to hundreds of hectares in sizes. Fish production from the stocked dams has, however, not been monitored for record purposes. Some trout farming is undertaken on a commercial scale around Cherangani hills and Eldoret areas.

Sport Fishing.

Sport fishing activities in the Lake Victoria Basin have hitherto been restricted to the colder highland regions. In these areas there are a number of good trout fishing rivers. Some of the rivers are open to licenced members of the public for sport fishing. Other sections of the various rivers are, however, controlled by Angling Associations and Clubs for the exclusive use by their members and guests.

It has recently been reported by the Kisumu based Senior Fisheries Officer that a general decline in trout fishery has been observed in the public rivers in Western Kenya. This decline has been attributed to shortage of staff which has led to inadequate management and patrol works, and consequently excessive poaching of the trout fishery in the rivers. He informed

me, however, that the sections of the rivers controlled by the Angling Associations/Clubs are well managed and are continuing to offer members and guests of the organizations good sport fishing.

In Kericho District there are three main trout rivers, Itare, Kiptiget and Kipsonoi. All the rivers are open for public sport fishing except for the upper reaches that are managed by the Kericho Angling Association. In the Kiptagat area there are the Naiberi, Kipsinendet and Kepchekwa rivers. These rivers do provide good sport fishing although they are currently patrolled by only one fish scout. There are some other rivers around Mt. Elgon and Cherangani Hills that provide good trout fishing. The constraint here, once again, is the lack of enough manpower to effectively patrol the rivers.

III EXPLOITATION, MANAGEMENT AND DEVELOPMENT OF THE FISHERIES RESOURCES

1. CAPITAL EQUIPMENT

Introduction

A wide variety of fishing equipment are used for the exploitation of the fisheries resources in the Kenya part of Lake Victoria and the rivers that empty into it. The equipment can broadly be classified into three groups: the fishing gear, fishing crafts and the means for craft propulsion. The choice of what type of fishing equipment to use is mostly dictated by the financial resources of the fisherman. However, the peculiar requirements of the equatic medium where the equipment is intended for use as well as the types of fishing equipment preferred by the local fishermen will also heavily influence the choice of a fisherman.

Fishing Gear

Fishing gear used in the Kenya waters of Lake Victoria and those rivers that enter into it may broadly be classified into two groups: the traditional gear and the modern gear.

The traditional gear are mainly used for subsistance fishing and include traps, baskets and spears. These equipment are usually constructed and repaired by the fishermen themselves. A negligible number of fishermen today use these traditional gear in the lake. However, some of the gear, especially traps, are often seen in use for fishing in the various rivers that lead into the lake. The great majority of the fishermen operating in the Kenya waters of Lake Victoria and the rivers that empty into it, such as rivers Yala, Kuja, Nzoia e.t.c., mainly use modern fishing gear. These include hooks and line,

gill-nets, mosquito nets, seine nets e.t.c. All the modern gear are purchased by fishermen from fishing gear dealers.

The most common type of fishing gear used by the fishermen operating in the Kenya side of Lake Victoria Basin are gill-nets. Gill-nets vary in type, size, price and resistance to wear and tear. The most common type is the multi-filament nylon net. Net sizes in common use are of $1\frac{1}{2}$", $1\frac{3}{4}$, $1\frac{1}{8}$", 4", $4\frac{1}{2}$", 5", 6" 8" 7" and 9" mesh sizes. The nets are usually mounted with ropes, twine, floats and sinkers. There are some people who specialize in gill net construction and do so for a fee. However, most of the fishermen know the techniques of mounting and repairing gill-nets fairly well except for the new comers to the occupation.

Gill nets will vary in prices according to number of plies in each. Currently, a 90 metre piece costs Kshs 41/= for a 2 ply net, Kshs 51/= for 3 ply net, Kshs 71/= for 4 ply net, Kshs 104/= for a six ply net and Kshs 450/= for a 21 ply net. Floats cost about Kshs 1/= each, sinkers Kshs 2/= each and mounting lines about Kshs 3/=. Gill nets are used for the capture of all types of fish in the lake except for Engraulicupris.

In his survey Wetheral (1974) estimated that there was an average number of 47 nets in each of the 3929 canoes used in the Kenya waters of Lake Victoria giving a total of 184,663 gill-nets. He further estimated that 54.7% of the nets were of small mesh sizes (0-3") 23.9% of medium mesh sizes (3"-5") and 21.4% were of large mesh sizes (5").

The service life of gill-nets depends on how often they are used, where they are laid and how well they are maintained. However, the average service life generally lies between 6 and 9 months.

In addition to gill-nets there are various other types of nets used for fishing in the lake. These include Mosquito and Beach Seine nets. Mosquito nets have meshes measuring 10 mm. each while Beach Seine nets have meshes measuring $1\frac{1}{8}$" each. Mosquito net is used primarily for the capture of Engraulicypris. It is estimated that a total of about 400 Mosquito seine nets are used in the Kenya waters of Lake Victoria.

Beach Seines are used for the capture of nearly all types of fish found in the close vicinity of open beaches where the nets are commonly operated. Beach Seines will catch even the immature stages of many species,

especially those that use the inshore beach areas as nursery grounds such as Tilapia. It is for this reason that beach seining is considered an extremely destructive technique of fish capture. It is estimated that a total of about 400 beach seines are operated along the shores of the Kenya Waters of Lake Victoria.

Mosquito and Beach Seine nets currently cost between Kshs. 610/= and Kshs. 727/= a piece and have service life of about one year. Both the nets are used in the lake for only eight months in the year. The period 1st April to 31st July of each year have been declared closed seasons, with respect to the use of the nets, by the Director of Fisheries.

Fishing Crafts

The crafts used by fishermen in the Kenyan waters of Lake Victoria and the rivers that empty into it are mostly canoes. They vary in sizes and can broadly be classified into four groups: Sesse canoes, "Jahasi" (Mashua), "Matarumba" and Dugouts. It is estimated that of the fishing canoes about 60% are Sesse canoes, 15% are 'Jahasis', 24% are "Matarumbas" and the rest are Dugouts and rafts. From the latest Fisheries Department estimate of 4599 fishing canoes it is worked out that there are 2759 Sesse canoes, 690 "Jahasis", 1104 "Matarumbas" and about 46 Dugouts and rafts operating in the Kenya waters of Lake Victoria.

The choice of what canoe to acquire depends on the financial resources of an individual fisherman, the area the craft is intended to be used, the gear the fisherman intends to use and the type of craft preferred by the other local fishermen.

All types of fishing canoes used in the Kenya waters of Lake Victoria are constructed by local boat builders, usually carpenters who have served as apprentices in the local boat building yards and developed expertise in the techniques of boat construction. The price of a canoe will depend on its size as well as the material used in its construction. Currently Sesse canoes (size range 18-30 ft) cost between 3,000/= and 5,000/= "Jahasis" cost between 4,000/= and 8,000/= "Matarumbas" cost between 2,000/= and 3,000/= and dugouts cost between 1,000/= and 1,500/=. The repair and maintenance costs of the canoes seem to lie between 100/= and 200/= per year although much will depend on age and handling of canoes.

The service life of fishing canoes will depend a lot on how well a fisherman handles his equipment. It is usually difficult to estimate the service life of the canoes used by the Lake Victoria fishermen because they tend to renovate and re-renovate their crafts several times enabling them to manage with one canoe for several years. According to information obtained from fishermen,Jansen (1973) estimated that "Jahasis" and Sesse canoes may last between 4 and 7 years while "Matarumbas" and dugouts could last much longer. Oduor-Otieno et al (1979) gave the service life of Sesse canoes as 10 years, "Jahasis" as 20 years and Dugouts as 15 years. For credit purposes we have estimated in the Fisheries Department that Sesse canoes would be able to provide economic service for a period of 8 years. From our own experience in the Fisheries Department we also estimate that "Jahasis" may be able to provide economic service for 5 to 10 years, while "Matarumbas" would last about 5 years and Dugouts about 10 years.

Equipment for Craft Propulsion.

The fishermen in the Kenya waters of Lake Victoria mainly use three types of equipment for the propulsion of their fishing crafts. These include oars, sails and outboard engines.

From Fisheries Department sources it is on record that only about 100 Sesse canoes are currently fitted with outboard engines. Most of the fishermen have, however, found that using outboard engines was less paying than, for instance, using sails and manpower (oars) as means of propulsion of boats to and from fishing grounds. In consequence, most of these boats, which were actually acquired through the "Fishermen Loans Scheme" of the Fisheries Department, are currently for the transportation of passengers and collection of catches from various landing beaches. Outboard engines of similar power (15-20HP) currently cost between Kshs 10,000/= and Kshs 15,015/=.

Most of the fishing canoes use sails for propulsion to and from the fishing grounds. Sails vary in sizes involving between 5 M^2 and 10 M^2 of cloth and cost between Kshs 200/= and Kshs 300/=. Sails normally have service life of between 1 and 2 years. Some fishermen use oars (manpower) for the propulsion of the canoes to and from fishing ground. Oars will cost just about Kshs 10-20/= each and last about one year.

The present fishing equipment are unsuitable for mid-lake fishing and are used in shallow waters mostly less than 5 miles from the lake shore. It was recommended by an EAFFRO/FAO project team in 1969 that a boat of the size of about 40ft. would be most suitable in exploiting the unused fish

stock in the lake.

The Fisheries authorities are currently constructing a trawler boat of about 34ft. long in Mombasa which, when completed, is expected to be handed over to the Mohuru Fishermen Co-operative Society. The boat is expected to form the nucleus of a trawl fishery in the Kenya waters of Lake Victoria, especially in the Mohuru region. The Mbita Fishermen Co-operative Society have also recently acquired a number of fairly large fishing vessels which they intend to use for trawl fishing in the Kenya waters of the lake in the near future. The likely impact of such a development will be discussed later on in this paper.

Investment in Capital Equipment

In the discussions above I have outlined the capital equipment employed for fishing in the Kenya part of the Lake Victoria Basin. I also tried to provide the current prices of the various forms of capital equipment outlined. From these prices we may work out an approximation of the total investment in the fisheries of an average fishermen in the lake.

1. Cost of a canoe (Sesse) =Kshs. 3,000/= to 5,000/=
2. Gill nets:
   (a) 2 Ply Net

Cost of one piece	= 51/=
Cost of 10 floats	= 10/=
Cost of Mounting Lines	= 9/=
Cost of sinkers @ 2/=	= 20/=
Labour Costs	= 20/=
Total Cost of 2 ply net	Kshs=110/=

As discussed above an average of 47 nets are used in each boat in the lake.

Therefore, the total cost of making 47 nets	= Kshs 5,170/=
Total investment in one fishing boat and gear	Kshs 8,170/= - 10,170/=

It has been mentioned earlier that the choice and amount of equipment to use largely depends on the financial resources of fishermen as well as other environmental factors. The great majority of the Lake Victoria fishermen employ what would be defined as intermediate technology involving use

of gill nets, hooks and line, seine nets e.t.c. in their endeavour to exploit the fisheries resources in the lake. Most of the fishermen are, however, poor and posses less gear than the average of 47 gill nets per boat given earlier in this paper. There are however a few well to do fishermen who in addition to tens of gill nets also possess others like mosquito nets, seine nets e.t.c.

It is noteworthy that the costs of operation differ with respect to individual fishermen's technology. The running costs are higher in the case of users of engined canoes since they have to meet additional maintenance and fuel costs. It has been said earlier, though, that most of the Lake Victoria fishermen use oars and sails as means of propulsion of their boats having established that it is less paying to use outboard engines on their present types and sizes of boats.

The really modern technology involving use of trawlers are only currently in their very preliminary stages of introduction in the Kenya part of the lake. Tanzania and Uganda fishermen have been trawling in their parts of the lake for some time now. The advisability of introducing trawling in the relatively shallower Kenya section of the lake, however, remains a controversial issue among fisheries scientists.

It has been argued that the Kenya fishermen would be able to reach most of the Kenya waters of the lake if only they slighly improved their present types of fishing equipment. Introducing more efficient trawlers in this section of the lake would, however, lead to diminished quantities of certain stocks, inevitably bringing an element of competition between the local fishermen and trawlers. Furthermore, reduced stocks would affect many fishermen by the imminent unemployment problem. This subject would, however, be taken up from other angles in later sections of this paper.

2. MANAGEMENT AND DEVELOPMENT OF THE FISHERIES RESOURCES

Introduction

The scientific basis for the management and development of any fishery resource embodies ecological, biological, economic and sociological considerations. The over-riding considerations will largely depend on the objectives of the fishing industry involved. In some countries recreation and aesthetic considerations may be over-riding in the management of inland fisheries resources. However, in the case of Lake Victoria, nutritional and economic needs of the people have been, and should of necessity continue to be, over-

riding. This is in keeping with the Kenya Government's declared objective to work for alleviation of poverty during the 1979-1983 Development Plan period. It is in this context that the management of the Lake Victoria fisheries resources has been discussed in this paper.

Present Management Requirements

The present state, trend in production and equipment used for the exploitation of the Lake Victoria Fisheries have been discussed at some length in the foregoing sections of this paper. It was established that the potential sustainable yield of the Kenya waters of Lake Victoria has not been achieved. Moreover, it was observed that the Lake Victoria catch is presently dominated by the small Engranlisypris, and Haplochromis fishes. What transpired most prominently too is that there is presently a preponderance of predator fishes including Bagrus, Clarias and Synodontis. The controversial Lates is the latest addition to the group of predator fishes in Lake Victoria. This leaves Tilapia as the major group low down in the complex food web of Lake Victoria.

The state of the Lake Victoria fisheries, outlined above, suggests great need for measures which may help in improving not only the quantity but also the quality of fish produced from the lake. This calls for the development of more efficient and selective methods of cropping the fishery. There is need also to work for the reduction in strength of some of the predators, as well as those fish groups that may not be universally popular with consumers such as Bagrus. Deliberate measures are also necessary aimed at increasing fishes popular with consumers such as Tilapia.

Fishing activities and the use of the various fishing equipment in Lake Victoria are governed by "The Fish Protection (Lake Victoria) Rules, drafted in accordance with the provisions of The Fish Industry Act (1968) (Cap. 378). These rules empower Fisheries Officers to issue "Beach Seine and "Mosquito Seine" permits subject to any conditions he may consider necessary to impose, on payment of 100/= and 20/= respectively. Other registered fishermen are free to use any set nets of any mesh measurements other than those that are 2" or more but less than 4" and of dimensions that are not greater than 100 yards in length and 30 meshes in depth for

fishing in Lake Victoria without payment of any fee. The Director of Fisheries is however empowered by the same rules to vary these regulations as he may think fit. Accordingly the Director of Fisheries has, since 1967, found it necessary to impose annual prohibition on the use of beach science and Mosquito seines in Lake Victoria from 1st April to 31st July. This prohibition was meant to lift fishing pressure off Tilapia Esculenta, whose breeding intensity increases at times of heavy rainfall (Welcome, 1969). The Director of Fisheries has, however, not found it necessary at any time to vary the rules relating to the use of gill nets or any other fishing gear. It is nonetheless submitted that it is only by careful variation of the use of the various fishing gear that one can hope to achieve the desired management objectives in respect of the Lake Victoria fisheries resources.

Desirable Management Variations

The optimum sustainable yield from the Lake Victoria fishery can only be attained by the deliberate cropping of mature fish only. This calls for the elimination of those fishing gear which will crop fish prematurely and increased fishing intensity in the presently lightly fished areas of the Lake.

The destruction perpetrated by using beach seine nets has been mentioned elsewhere in this paper. These nets will damage the breeding and nursery grounds and catch practically all the species including juveniles of the Lake Victoria fishes. It should be noted that there is no single fish species which cannot be cropped by other fishing techniques presently employed in the lake. It is therefore, felt most expedient that the use of beach seines should completely and immediately be prohibited in Lake Victoria. This would give some of the juveniles in the beach areas a chance of growing to maturity and replenishing the Lake Victoria fishery.

Mosquito seine nets should, however, continue to be used because they mainly harvest the under-fished Engraulicypris. Close surveillance should, however, be kept over the use of these nets to ensure that they are not destructive to the rest of the Lake Victoria fisheries.

The small mesh gill nets presently used in the lake could be doing some harm by cropping the premature stages of some of the fish species. Nets below 17/8" are currently used to harvest Haplochromis. These nets are, however, too small and have probably caused the virtual disappearance of the larger species of Haplochromis (Wanjala, 1973). Scully (1975) also thought that this size range was too small to harvest the majority of Haplo-

chromis species. He further established that Haplochromis and Synodontis are most effectively harvested by the gill net range of 17/8" to 2½", which Wanjala and Marten (1973) felt do not remove significant numbers of juvenile Tilapia. These nets will, however, prematurely harvest other large fishes like Bagrus, Clarias, mormyrid, Labeo and Schilbe. This problem could possibly be solved by considering the use of the zonation in distribution displayed by the various fish species in the Lake for management purposes. Haplochromis and Synodontis, are for the most part in the off-shore areas of the Lake. Most of the other fish groups are however mostly in the inshore waters.

In light of the arguments advanced above it is strongly felt that appropriate management of the gill fishery could greatly be facilitated by creating ecological zones in the Kenya waters of Lake Victoria for the purposes of regulating the use of the various sizes of gill nets. No definite zones are being suggested. The criteria for zonation could, however, be based on the pattern of fish distribution and the desire to separate such fish groups as Haplochromis, Synodontis, etc. that are normally found off-shore from the rest of in-shore populations.

In the case of "in-shore" zone it is thought that the management objective outlined above would be achieved if only longliness and gill nets of mesh measurement 4" and above are legalized. This would facilitate effective exploitation of the larger fishes without cropping the immature stages of any of them. It is found necessary to emphasize here that hooks should heavily be used in this zone to more effectively exploit Clarias and Bargrus and consequently stimulate the increase of their prey, Tilapia and Haplochromis. In the "of-shore" zone, however, it is suggested that gill-nets of sizes 17/8" to 2½" and also 4" and above only be used. Longlining could also be conducted in this zone.

It has been thought by a number of fisheries scientists that the Tilapia population could be increased in Lake Victoria by a re-stocking programme. They suggest the establishment of many fish ponds, in various sheltered bays around the lake, in which Tilapia fingerlings could be produced and then released into the protected bays. This could probably work. There is, however, the risk that pond produced juveniles are usually not hardy enough to be able to cope with forces of competition and predation in the wild. There are, therefore, chances that most of the juveniles will die before reaching maturity.

Mention has been made in the previous section of the proposal to introduce trawl fishery in the Kenya waters of Lake Victoria. The Nyanza Gulf is mostly shallow with depth range between 4 and 15 metres. In most of their surveys fisheries scientists (Marten et al, 1975; Kudhongania - Akiki et al 1975) have recommended that trawling should not be carried out within 10 miles of shore or in any areas less than 20 M. deep in Lake Victoria. The argument is that this area currently sustains the predominant inshore artisanal fishery and also Haplochromis stocks for which trawling could be of economic value have greater commercial stocks off-shore.

These arguments are most sound. It would consequently be most inadvisable to do any trawling in the Winam Gulf. The open waters of the Kenyan part of Lake Victoria are also restricted in area and may not possibly be able to accommodate more than three trawlers if they have to operate economically.

Development of Fish Culture

The decline in the fisheries of some species, especially Tilapia, in Lake Victoria has been discussed in details in some sections of this paper. Moreover, even with the best management techniques the yield from Lake Victoria can at best be expected to only double the present level. The population around the lake will however, continue to rise not only requiring additional gainful employment but also increased sources of food. Fish culture within the lake itself as well as in the rest of the lake Basin could provide long term solutions to some of these problems.

Studies have shown that Tilapia held in cages in Lake Victoria can grow very rapidly (Ibrahim et al, 1975). There is usually an abundance of planktons in Lake Victoria which the caged fish could satisfactorily live on. In order to achieve faster growth, however, the fish may be provided with supplementary food. There is the obvious advantage in this technique in that by holding the fingerlings in cages they are fully protected against predators and may grow to marketable sizes with minimum loss.

There is also considerable potential for fish farming development in the rest of the Lake Victoria Basin. What work has been going on in this field has been discussed earlier in this paper. It was noted that the exact potential has not been ascertained although it is generally known that the essential requirements, such as suitable water and land, are available. The

low production in the present ponds could be attributed to lack of know how and interest in fish farming. In order to develop interest and increase production from this sector of the fishing industry it will be necessary to uplift fish culture in the region from its present artisanal level of fully commercial status. This will require not only a regionwide education programme, through extention services, for would be fish-farmers but also the establishment of demonstration fish farms, at least one in every administrative division, that could provide the example of ideal fish farms and stimulate fish farming development in the region.

Sports Fishing Development

There is a potential for sports fishing development in the whole of the Lake Victoria Basin to augment facilities for tourism in the region. Mention has been made of the potential offered by the Lates fishery in Lake Victoria. The trout fishery in the highland areas has also been discussed. The potential offered by the fishery in the rivers in the lowland areas of the region could also be considerable. The Lates fishery in Lake Victoria is fast establishing itself. Not much is required to further develop it except to avoid destructive fishing of it.

The trout fishery in the region currently suffers management problems due primarily to shortage of staff in the Fisheries Department. First there is urgent need to increase staff for this sector. There will also be need to select only some of the rivers for regular restocking, intensive patrol and maintenance of fishing sites along the banks. In addition some more fishing camps could be established close by the fishing sites to facilitate tourist traffic to these areas.

Management of the Riverine Fisheries.

The fisheries (other than trout) in the rivers emptying into Lake Victoria are only protected by the "Fish Protection (Lake Victoria) Rules" from their points of entry into the lake up to a point five miles measured along the banks of each of them as if each such portion were included in Lake Victoria. These rules have nothing against the use of indigenous fishing equipment such as traps. The result has been that the local fishermen have used these fishing equipment so effectively that some of the riverine species such as Barbus, Labeo etc, have drastically reduced. These species are delicacies, especially to the lakeside population.

In light of these observations it would be most logical if appropriate rules were drafted for the management of the riverine fisheries. This may call for research into suitable fishing techniques for the rivers. In the meantime, the use of most of the traps in the rivers should be prohibited. This would at least help release the fish of some fishing pressure while investigations continue.

IV FISHERMEN

Introduction

The psychological features of a fishing population could provide useful guide for the isolation of those socio-economic factors that may influence development proposals in a fishing industry. For this reason we need to understand fishermen fairly well in order to be able to rationally define the development strategies which may be required for achieving the optimum sustainable yield in any fishery.

Fishermen play a vital role as primary producers (in economic terms) in the fishing industry. Their main interest lies in landing the largest catches possible of economically and nutritionally important fish from fishery. Fishermen will, therefore, go hunting and exploiting such valuable fish species wherever they may be and by whatever means possible, whether legal or illegal. The Lake Victoria fishermen will keenly take care of their fishing equipment to ensure effective exploitation of the fisheries in the lake. Nevertheless, the same fishermen have a tendency of using illegalized gill nets such as those of mesh measurements between 2" and 4" ($2\frac{1}{2}$" gill nets are legal) to ensure increased catches albeit of immature stages of such species as Tilapia esculenta.

Many people have defined fishermen as a race in themselves. They are generally a conservative group with similar interests who tend to stick together. Fishing villages were once quite common along the shores of Lake Victoria although lately they have dissappeared. Their disappearance can be accounted for by the recent interest in individual ownership of land. However, fishing villages are still quite common in other places like Lake Turkana, the Coastal region and dams on the upper reaches of river Tana. This tendency could be useful and has effectively been exploited by the Fisheries Department authorities in developing successful Fishermen Co-operative Societies at the Coast and Lake Turkana.

Fishermen usually hold some tabboos dear to themselves and strongly believe in luck. The Coastal fishermen for instance believe strongly that God predetermines their fish catches each day (Okidi, 1978). Whatever they get is supposed to have been a gift from God. This is also the case with Lake Victoria fishermen. It may be necessary to try to change this attitude in order to adapt fishermen to the development needs of the present. I agree with Okidi (1978) that such efforts would require well-founded sociological and anthropological studies by the fisheries authorities.

The value attached to the fishing occupation will also influence adaptations of fishermen in any development proposals for a fishing industry. Fishing is usually, especially with the present state of technology in use in the Kenya waters of Lake Victoria a very hard type of manual work. The occupation is physically insecure, particularly with the canoes presently used by the Lake Victoria fishermen. Every year there are reports of drowned fishermen in the Lake. Moreover the present levels of returns to fishermen, as will be seen elsewhere in this paper, also make the occupation economically insecure. This is worsened by the tendency of fishermen to spend their daily income almost immediately as it comes, with the result that little is left for saving in cash. Nearly all fishermen in Lake Victoria do not pay direct taxes for the reason that they are considered to be poor. It is quite common to see fishermen go in rugs and even their living and housing conditions are usually poor. The result of all this is that the fishing occupation is viewed by members of the public to be of low status. What is worse is that even the fishermen themselves hold a low opinion of their own occupation. This has led to a situation where the relatively rich fishermen will prefer to employ a labour force to operate their gear while they find time to engage in other more palatable business. Many fishermen would, therefore, mostly abandon fishing as soon as an alternative occupation crops up.

This negative attitude about the fishing occupation has to be dispelled by all means possible if the Lake Victoria fishery has to be managed and developed for increased production and benefit of all. One is tempted to suggest that more modern and expensive equipment be introduced for the exploitation of the Lake Victoria fisheries to make fishermen and members of the public value the level of investment involved. What matters in an industry like fishing, however, is not the cost but the propriety of the equipment and technology involved.

The cultural background of fishermen could probably also influence the adaptations necessary in the development of a fishery. In the Lake Victoria region, especially in the Luo Community that form 90% of the fishermen in the Kenya Waters of Lake Victoria adults are traditionally considered as distint and separate economic Units in the sense that property will be owned by individual heads of households. Profits that may accrue from enterprises will return to individuals even if the business is jointly owned. What this implies is that cooperative efforts may be fairly difficult to forge among this group of people. The Lake Victoria fishermen have amply varified this. Of all the Fishermen Co-operative Societies in Kenya it is those in Nyanza and Western Provinces that have been most unprogressive. There have been persistent wrangles over their management, leadership, and operations leading to inactivity, formation of splinter societies or complete break up of the various societies.

The future development of the Lake Victoria fisheries, like in other places, will largely depend on collaboration among fishermen. It, therefore, seems necessary that the spirit of co-operation for the enhancement of the fishing occupation must be developed in the fishermen. This would require concerted efforts to educate the fishermen on the benefits of revitalizing their Co-operative movements.

Investment By Fisherman

Fishermen are strongly traditional in nature, and will usually tend to invest more in the traditional economic sector. To members of the Luo Community cattle is the traditional embodiment of Wealth. The Lake Victoria fisherman will, therefore, first provide for the needs of his family and take care of his fishing equipment but thereafter plough any extras from his income into livestock. Livestock may then be mobilized for investment in other economic sectors. Many of the fishermen will usually also mobilize their cattle for other purposes such as marrying additional wives. Many of the Lake Victoria fishermen are polygamous.

Fishermen may be traditional in their various tendencies. I nevertheless think that the very strong inclination to invest in the traditional sector normally seen in the Lake Victoria fishermen may also be explained by the remoteness of the fishing areas from any major commercial and banking centres. This has amply been verified by the relatively rich fishermen who have shown keen interest in investing in the various modern commercial sectors. Many

of such fishermen own buildings, retail businesses and even bank accounts in major commercial centres.

What this seems to imply is that with good enough income, a fisherman will be able to completely abandon his traditional tendencies and take to competing with others in other economic spheres of life, both traditional and modern.

Recruitment of Fishermen

It is currently absolutely easy to enter the fishing occupation. Those intending to use indigenous traditional methods of fishing in Lake Victoria may be issued with a free 'Indigenous Fisherman's Licence" by the Kenya Fisheries Department officials subject to the provisions of the Fish Industry Act (1968) and also the Fish Protection (Lake Victoria) Rules. Even those intending to use modern fishing gear will only need to acquire the necessary equipment and then launch into the fishing occupation for a nominal fee.

Many people start off as employees of other fishermen and in the process gradually acquire the necessary equipment which eventually may enable them to launch themselves fully into the fishing occupation. Some people are afforded a few fishing equipment or credit facilities by relatives, friends and even the local fish-mongers for purchasing the fishing equipment that would enable them to launch into the occupation. Such people are allowed to repay for the advances either with their catches or with the cash realized through the sale of their landings. All in all once a person acquires the necessary equipment the door is wide open for recruitment into the fishing occupation.

In spite of what has been said above the fishing occupation has often been regarded as the cultural heritage of the Lake population. The great majority of the fishermen in the Kenya Waters of Lake Victoria were born and live close to the shoreline.

In a recent development people from inland areas have started to be recruited into the fishing occupation. These people are usually farmers who join the occupation with little or no knowhow on the techniques of fishing. They are usually young men who have failled to get employment elsewhere and take to fishing as a last resort. These people are usually inducted into the fishing occupation by the lakeshore fishermen who are usually old hands at the trade.

Fishermen may be classified into two groups depending on whether they are full-time or part-time fishermen. The full-time fishermen will usually be fully involved with an almost completely dependent upon the occupation for their livelihood, sparing very little of their time for work on their shambas. This category will migrate from one region of the lake to another chasing the migratory fish species. It is also this group that are usually engaged in outward migrations from the Lake. Many fishermen moved from Lake Victoria to Lake Turkana and man-made lakes in the Upper Tana river in the early 1970's to explore the virgin fisheries in these lakes.

The seasonal or part-time fishermen are usually people with major interest in farming. They would only go fishing for food and some little extra income for extra family needs. They will rarely fo chasing after the migrating fishes, preferring to fish from home throughout the year. In fact, this category only actively engage in fishing when there is little to do on the farms.

There is also one group of people who are basically non-fishermen but who may own fishing equipment. This group is usually composed of people like teachers, government employees and various groups of wage earners who, like the part-time fishermen, only depend on their meagre investment in the industry for food and some little income for extra family needs. They usually employ labour to work their equipment.

The full-time fishermen who depend almost entirely on fishing for a livelihood should be enabled to derive maximum sustainable returns from this occupation. One is, therefore, tempted to suggest that recruitment into the fishing occupation should be regularized and based on clearly set out criteria. It should be made more difficult for people engaged in other occupations such as farming to join the fishing occupation.

Theft of Equipment

Theft of capital equipment is quite common among the Lake Victoria fishermen. The equipment that get stolen most are the fishing gear, the crafts being spared probably because of their bulkiness. The well-to-do fishermen will suffer loss of their equipment more than the poor ones. In most cases theft will be committed while the gear are still in the lake and there are no other fishermen in close vicinity. The thieves will usually emigrate to other landing beaches with their illegally acquired equipment. Theft of fishing gear is, however, most rare in the Kenya Coast.

Jansen (1973) attributed this tendency to poverty and possibly revenge arising out of some previous dispute. While I agree with him I also think that the tendency may be explained by the egalitarian of the Luo Community who form the bulk of the Lake Victoria fishermen. It is strongly held here that when a person is in possession of plenty of one type of asset he ought to share part of it with his relatives, friends and neighbours.

In order to prevent theft of equipment the Fisheries Department authorities and fishermen have designed a system requiring emigrating fishermen to obtain a certificate from his beach leader detailing his equipment before departure. He is expected to present the said certificate to the leader of the beach he emigrates to.

In some places the fishermen park their canoes in one beach to facilitate monitoring of movement of individual fishermen to and from the fishing grounds. In most cases the fishermen are expected to mark their equipment to enable identification in case of loss. Inspite of these efforts theft of fishing equipment among fishermen has continued to prevail in Lake Victoria.

Theft of fishing equipment is a retrogressive tendency bound to affect any development proposals for the Lake Victoria fisheries. It must therefore, be stopped by all means possible to acertain the establishment of an environment conducive to honest co-operation among the fishermen for development. Theft of equipment will certainly decline if the fishermen are assured of income beyond the poverty line. This can be achieved through increased production from the Lake Victoria fisheries. There will however, be need to enforce some of the rules mentioned above more thoroughly and also to educate the fishermen against the entrenched egalitarian and theft tendencies.

Organization and Operations of Fishermen

The basis of organization and operations of fishing community usually depends on the system of ownership of equipment in a fishing industry. What seems to be at play in the Lake Victoria fishery is a fine mixture of egalitarianism and individualism. There is a strong tendency towards individual ownership of the fishing equipment. No person will, however, own more equipment than he can individually be able to manage. It is only in very rare circumstances that brothers or relatives will be able to pool their resources together to acquire fishing equipment.

These tendencies could certainly act as constraints to development possibilities in the industry. Effective exploitation of the Lake Victoria fisheries may require heavier investments involving larger sums of money than may currently be afforded by individual fishermen. It has been discussed elsewhere in this paper but I still wish to emphasize here of the great need for forging the attitude of co-operation among fishermen for the more effective exploitation of the Lake Victoria fisheries resources.

Fishing is usually conducted in and affected by varying weather and environmental conditions. Fishermen should therefore be well informed of such factors as winds. Currents water depths, fish movements and conditions of fishing grounds. Usually in a canoe there is someone who possess this knowledge, the Skipper who, unlike the modern skipper who uses navigational and other scientific equipment to monitor the weather, movement and operations, acquires his knowhow through years of experience of fishing in the same waters. The "Skipper" is usually the head of operations in the canoe directing movement and other activities like where to fish and for how long.

Operating gill nets, the predominant gear used in Lake Victoria requires more than one person. The number of fishermen in a canoe will therefore commonly vary between 3 and 5 depending on such factors as the state of the weather, number of gear involved, size of boat etc. It is not uncommon, however, to find some canoes, especially those operating small meshed gill nets manned by one or two people only.

The system of setting gill nets vary from one place to another and also depends on the type of fishermen involved. The gill nets are usually set 3 to 5 miles off the shores. In some places the fishermen will leave the gill nets set in the lake, only bringing them out once a week for cleaning and repair purposes. In such cases the fishermen will leave every morning in their canoes to clear the nets of fish and return to the landing beaches by noon.

In other places and during certain seasons, however, the fishermen will set their nets in the evening and either wait by the nets sleeping in their boats or set off very early in the morning to bring both the nets and fish captured back to the landing beaches in the morning.

One interesting aspect of the operations of the Lake Victoria fishermen is that most of them prefer spreading out their gear in different canoes

to guard against bad luck and to be able to exploit different grounds at the same time. Some canoe owners may, however, prefer to place all their gear in one canoe and at the same fishing ground, although this category are in the minority. Even then, there is a limit to which one can spread out one's fishing gear. It is not common for fishermen to distribute their gear in more than three canoes.

The canoe owner will usually agree with the "Visitor-gear-owners" on a system of payment commonly known as "Mich Mar Yie" (Gift for the Canoe). This is commonly 10% of the total catches from the nets. Even the canoe owner himself will be expected to set aside about 10% of his catch each time for the maintenance of the canoe.

In cases if hired labour the fishermen will mostly get a relative to take charge of his canoe (Skipper) to guard against theft of fish by the employees. The system used for payment in such cases is variable and dependent on an agreement between the fishermen and his labour. Cash payment is quite common. In addition the employees usually receive bonus and food allowance from his catches. The payment could also solely be in the form of fish landings. The fishermen may agree with his employees on what proportion of the catches to be paid either per week or on a daily basis.

Many full-time fishermen are compelled to go on migration trips when fish is scarce in their home area. Migration is usually a consequence of economic dependence on fish. Probably this could be avoided by developing intermediate technology with bigger boats for the exploitation of the fishery resources. The system of out-migration to other lakes is search of greener pastures elsewhere has been mentioned in earlier section of the paper.

It is generally acknowledged by the Fisheries Department that the fishermen in the Kenya Waters of Lake Victoria have much knowledge about their fishing occupation. This could be most invaluable in any future development proposals regardless of what type of technological equipment may be invloved. It may only be necessary to mount some little training programmes to adapt the fishermen to any modern and mechanized fishing which may be introduced.

V. FISH MARKETING

Introduction

Fish is a highly perishable commodity that should find its way to the consumers soon after being landed or must be preserved properly to enable it to maintain quality while in the process of being marketed. This calls for the development of good communication systems, such as roads, between the landing beaches and the outside markets to facilitate fast distribution of the fresh commodity, establishment of fish preservation and processing facilities at or near the landing beaches, and the provision of appropriate transport facilities. Otherwise much of the fish landed will run the risk of going to waste before reaching the inland consumers.

At present most of the access roads to the landing beaches on the shores of Lake Victoria become inaccessible during the rains, severely affecting fish trade in such areas. The Fisheries Department has, however, done a commendable job of constructing "Fish Landing Depots" at most of the major landing beaches. Nevertheless, most of the depots are wanting in fish processing and preservation facilities. Suitable transport, especially for fresh fish, is also conspicuous by its absence in nearly all the fish landing beaches in the region. These short-comings have apparently influenced the development of the present system of fresh fish marketing in the region.

Systems of Fish Marketing

The marketing of the fish landed from the Kenya waters of Lake Victoria is very much decentralized and labour intensive. The fishermen do not usually market their fish directly to consumers except in one of the smallest and isolated beaches. There is usually a middleman between the fishermen and consumers.

The great majority of the dealers in the Lake Victoria fish are women. There are also a few young men who normally ferry their fish load from the landing beaches to the inland markets on bicycles. The number of these fish dealers commonly fishmongers usually vary directly with the quantity of fish landed. Their number will increase when fish supply increases and vice versa. This means that many people try to cash in on the temporary situation of increased abundance to earn some little money and abandon the business immediately there are signs of decline in catches.

The fishmongers are generally small business people. They possess very little capital for their business. It is probably because of this reason that the business of trading in fish landed from the Kenya waters of Lake Victoria has been able to sustain so many fishmongers. They usually purchase only enough quantity of fish that they would be able to transport partly on their heads or bicycles and partly by public means to the nearby markets. Jansen (1973) reported that the women normally purchase fish valued at about 100/= and made a profit of about 3/= a day. I think that the profit margin could be a little higher than this, even Jansen's analysis concedes that with their income they were able to purchase domestic necessities and still be left with savings for other uses.

It should be pointed out that there are some few companies and people that currently undertake large scale business in the Lake Victoria fish. Such companies and individuals collect fresh or processed fish from the various landing beaches mainly for marketing in the big towns around the country.

It is reported from Fisheries Department Statistics sources that between 60% and 70% of the total fish catches from Lake Victoria is marketed fresh. The remainder is sold in processed form as sun-dried, smoked or salted fish.

The fishmongers are normally adept at marketing their fish. They will usually manage to dispose of nearly all their fish at a particular market is one day. However, if any fresh fish is left unsold on a particular day, this would usually be processed by sun drying, smoking or salting and brought back to the same or other market on another day. Some fish like Haplochromis will nonetheless give the fishmongers problems in some markets like Kisii where they may be in low demand.

Lake Victoria Fishermen Co-operative Societies

It is the policy of Kenya Government to encourage the development of fisheries co-operative societies as a means of improving the livelihood of the fishermen. According to sources in the Department of Co-operative Development and Fisheries Department, there are currently 34 registered fishermen's Co-operative societies in Kenya. The great majority of these societies, 21 in all, are in Lake Victoria. Table 6 provides the list of the 21 societies with details of membership, estimated turnover and present state of activity of each of them.

Table 6. List of the Fishermen's Co-operative Societies in the LVB in 1977.

District	Society	No. of members	Turnover	Status
Busia	Bunyala	307	12,410 (76-77)	Not active
"	Samia	297	10,000 (76-77)	Not active
Siaya	Yimbo	185	70,948 (75-76)	Active?
"	Uyoma	150	69,019 (75-76)	Active?
"	North Sakwa	?	-	New
"	Wichlum	?	71,001 (75-76)	Active?
"	Asembo	?	-	New
Kisumu	Dunga	50	10,686 (76-77)	Active
"	Kaloka	134	187,323 (76177)	Active
"	Nyakach	18	7,061 (76-77)	Dormant
Homa Bay	Mbita Fishermen's Co-operative Union:			
"	Rusinga	500	?	Active
"	Gwassi	90	?	Active
"	Homa Bay	373	15,010 (76-77)	Active
"	Kendu Bay	200	85,324 (75-76)	Active
"	Muhuru Bay	180	27,858 (75-76)	Active
"	South Kadem	110	?	Active
	The others:			
Homa Bay	Gembe	200	?	Active
"	North Kadem	115	?	Active
"	Mfangano	?	?	Active
"	West Karachuonyo	?	?	Active
"	Kaksingri	?	-	New

Note

Adopted from the report of the Nordic Consultant, H. Mikkola, for Fisheries Co-operatives made to the Department of Co-operative Development in January, 1978.

Membership of the societies is optional. In most cases the fishermen opt to stay out. They argue that in their present structure and state not much can be gained by joining the societies. Of the estimated 18,000 fishermen in Lake Victoria only 3,800 (21%), are members of the 21 registered societies. According to information from the Department for Co-operative Development the overall annual turnover of all the Lake Victoria Fishermen Co-operative Societies put together is currently about 980,000 shillings (1976). This is only about 4.1% of the recorded total earnings of fishermen during the same period (1976). It must therefore, be that most of the fishermen, members and non-members alike, sell most of their catches outside the societies. The incentive to use the marketing services of the societies is evidently negligible indeed. This calls for measures aimed at strengthening the societies by developing fishermen's interest in them, most appropriately through an education programme.

The Fishermen Co-operative societies are established mainly to provide marketing services to fishermen. In addition they could provide the medium for the convenient provision of credit facilities and extension services to fishermen. The societies themselves may also provide credit facilities and other services such as the provision of equipment to fishermen on easy and convinient terms.

The Lake Victoria Fishermen Co-operative Societies would only be expected to provide modest services, in their present forms. Apart from collecting commission from fishermen the Societies currently provide no services to the fishermen who, actually, sell their fish directly to dealers. The lack of success in the operations of the Fishermen Co-operative Societies has been attributed to management financial and marketing problems (Development Plan, 1979-1983). This may be so but the root of all the problems must be related to the question of the viability of each of the societies as separate and independent economic entities.

I suppose that before taking a decision to register any co-operative society the Department of Co-operative Development carries out background investigations to determine the possible viability of the proposed society. The rules of the various societies are after all drawn up according to models provided by the department.

What transpires quite prominently by examining the potential membership and turnover of each and every one of the registered Lake Victoria Fishermen Co-operative Societies, however, is that none of them can possibly survive as economically independent and viable institutions. The average monthly Commission collection for most of the Societies lies between 300/= and 700/= (Miklola, 1978). This is hardly enough to pay the clerks collecting the commission. Moreover their operational capabilities are considerably limited by the apparent lack of enlighened management. The management staff usually hace very little formal education and the committee members are mostly illiterate.

The proliferation of the Fishermen Co-operative Societies around Lake Victoria can also partly be blamed on the fishermen themselves. Much has been said elsewhere in this paper on some sociological aspects of the fishing population in Lake Victoria. Nearly all the Co-operative societies have been formed on the basis of locational administrative boundaries around the lake. Despite the existence of the numerous societies covering the entire Lake Victoria region, some new societies are currently in the formation as splinter organizations of the registered societies. East Uyoma fishermen have applied to be registered as a society independent from the the original Uyoma Fishermen Co-operative Society.

What has been established by my above argument is that practically all the Lake Victoria Fishermen Co-operative Societies are too weak for any independent economic operation. The potential turnover and membership are too low for a viable co-operative society in each case. They lack financial ability to develop facilities such as cold stores, ice plants, transport, credit schemes, etc. which may enable them to fulfil their objectives. And I wish to submit that even with very intensive supervision and excessively generous assistance the various societies cannot possibly manage to survive as independent economic entitites. The situation is such that the fishermen have been and will continue to be exploited by fishmongers. There is therefore a strong case for the reoganization of the co-operative societies so that they may be able to serve the fishermen as desired.

The first and most important requirement appears to be the need to interest fishermen in co-operative movements. There will be need to mount widespread education programme aimed at enlightening the fishermen on the values of co-operative movements. The success of any re-organization programme will certainly depend on the understanding and genuine desire of fishermen to develop viable co-operative organizations.

I have argued that the root cause of the lack of success of nearly all the Lake Victoria Fishermen Co-operative Societies is their smallness. This factor militates against economic viability of each and every one of the societies. Table 6 gives the average turnover of the various Fishermen Co-operative Societies. For comparison purposes and in corroboration of this point I wish to cite the case of the largely successful Lake Turkana Fishermen Co-operative Society. Here, there is only one Co-operative Society. Here, there is only one Co-operative Society for the 3,000 fishermen in Lake Turkana and has a turnover of 3-5 million shillings. Similarly the other successful North Coast Fishermen Co-operative Society is the only one serving all the fishermen in Lamu District with 500 members and a turnover of 1.9 million shillings. The cardinal point here is that the Societies need to be big and potentially, financially secure enough in order to be able to serve members well and survive as economic entities.

In view of these observations it is felt that there is a strong case for complete reorganization of the Lake Victoria Fishermen Co-operative Societies to ascertain their operational and economic viability. One is tempted to suggest the marger of all the Societies into one big Lake Victoria Fishermen Co-operative Union with a potential turnover of 24 Million Shillings. For administrative purposes however, it may be reasonable to go along with Mikkola (1978) who proposed the merger of the Societies into two Big Unions, one for fishermen on the Southern end of Lake Victoria and the other one for those in the Northern side of the Lake. Possibilities could also be explored for the merger of some of present societies into bigger entities which would then serve as economically viable branches of the Fishermen Co-operative Unions. The fish farmers could also benefit by joining the proposed Fishermen Co-operative Unions.

In order to be able to achieve efficiency in management and operation it looks sensible that the Unions should seek for the services of only qualified personnel. The Department of Co-operative Development would need to take a keen interest in this and, if need be, second some of its own personnel to the unions to enable their establishment on sound bases.

The smooth operations of the Fishermen's Co-operative Unions could greatly be enhanced by restricting fish landing to only some few well developed beaches to facilitate the handling and marketing of large quantities of fish. The Fisheries Department would need to take a keen interest in this by facilitating the oppropriate development of the beaches. The Ministry of Works would also need to be interested in the development of good roads to the landing beaches.

The Unions will require capital to enable them to successfully develop the facilities necessary for the achievement of their objectives. The two departments, Fisheries Department and the Department for Co-operative Development will have to strongly come to the aid of the Unions to enable them to either acquire the credit required and/or develop the necessary facilities. Probably this is the only area where the LVBDA should strongly come in with generous financial assistance.

It should have been clear in other sections of this paper that the Lake Victoria fishermen are mostly poor. They will, therefore, only have more hope of raising income from their occupation through co-operative efforts. It is thought that only well organized co-operative societies will be able to serve the fishermen properly and provide the desired medium for the implementation of government policies aimed at improving their livelihood.

VI. EMPLOYMENT

What constitutes a fishing industry? It is only by correctly answering this question that one would be able to clearly discern what employment opportunities may exist in a fishing industry. To most people a fishing industry involves fishing period. This may be correct but not all. Fish production generates many and closely linked economic niches all of which go into forming a fishing industry. First there is the manufacture or fabrication of the equipment used in fish production such as fishing crafts, fishing gear, and equipment for craft propulsion. Next, there are those activities relating to the marketing of fish. There are also those activities that have developed as a result of the fishing activities. It appears logical that all these areas, including the actual processes of fish production, should be considered when discussing the constitution and employment opportunities within any fishing industry.

In the last 10 to 20 years there has been a rapid increase in the number of fishermen operating in the Kenya waters of Lake Victoria. In 1973 Jansen estimated that there were about 10,700 fishermen in Lake Victoria. He further estimated that these fishermen belonged to households towards which they had full financial obligations and numbering a total of 80,000 people. Although no surveys have lately been conducted to assess the exact increase, according to Fisheries Department sources, it is estimated that currently there are about 18,000 fishermen operating in the Kenya Waters of Lake Victoria and supporting a total of about 120,000 people.

It has been mentioned elsewhere in this paper that nearly all the boats used in the Kenya Waters of Lake Victoria are built and repaired locally by carpenters who have developed expertise in the trade. Whetheral (1974) estimated that there were 3,929 canoes operating in the Kenya waters of Lake Victoria. Jansen (1976), however, assessed that this number had considerably increased to about 4599 canoes by 1976. Considering that the service life of most of the canoes in the lake is between five and eight years one may logically conclude that there is a thriving boat building industry for the fishing occupation in the Lake Victoria. No survey has been conducted to determine the number of people engaged in boat building for fishing but from my above analysis it is evident that it must be considerable.

There is only one fish net manufacturing factory in Kisumu employing 100 people. Although the factory supplies nets used for fishing all over the country the extent to which the Lake Victoria fishing activities sustains employment in the factory can only be measured in terms of the volume used by the Lake Victoria fishermen. Wetheral (1974) estimated that a total of 184,663 nets are used by the Lake Victoria fishermen compared to about 20,000 nets used by the Lake Turkana fishermen (assuming same number of nets per boat in each case).

It is estimated that about 3,000 people are presently involved in artisanal fish farming in Nyanza and Western Provinces. These people cannot, however, be considered to be gainfully employed in the fishing industry not only because they are culturing fish mostly at subsistance level but also because they are doing it side by side with other economic activities especially on land. It is thought, however, that there is vast potential for fish farming development in the region and to the extent that it could provide more people with employment, more gainful than either on land or fishing in the Lake.

The numerous fishmongers mentioned repeatedly in other sections of this paper also derive large parts of their income from the fishing industry. In fact quite a number of them are presently engaged in fish trade almost as sole means of earning livelihood. It has not been possible to estimate the number of such people engaged in the business. I find it necessary to point out that this group of people are currently very important to the industry because they are instrumental in the marketing of most of the fish produced. They are, however, likely to be hit very hard, possibly by being completely put out of employment, should the co-operative societies be strengthened and enabled to fully undertake the marketing of fishermen's catches.

In addition to the various groups already discussed above, a large number of service institutions have developed around the fishing industry providing gainful employment to a sizeable number of people. Many people have been able to organize small hotels near the landing beaches where they serve refreshments to the fishermen and fishmongers. Further, there are those involved in the repair sector of the capital equipment used in the fishing industry. Mention should also be made of money earned by people providing transport to fishmongers with their fish to the fish markets.

VI. INCOME TO FISHERMEN

In order to be able to assess the economic situation of the Lake Victoria fishermen an attempt ha been made here to analyse their annual earnings from fish catches over the period 1968 through 1977. It is noticed in Table 1 and Figure 11 that the fishermen's earnings or the value of annual fish catches varied in conformity with fish production over the period under consideration. When the production decreased from 17,442 tonnes in 1969 to 14,918 tonnes in 1971, earnings by fishermen also reduced from 16,047,000 Shillings to 15,333,000 shillings respectively. After 1971 fish production gradually increased to the highest figure of 19,332 tonnes in 1977. Similarly annual earnings by fishermen gradually increased to 25,681,000 shillings.

I wish to observe, however, that the variations exhibited by fish production and earnings by fishermen (value of total catches) over the period under analysis do not seem to display any direct relationships. In economic terms it seems as if the variations in the price of fish during the period was controlled both by forces of inflation as well as the "law of supply and demand", fish being a commodity whose market price is uncontrolled in Kenya. The reduction in tonnage of fish produced in the period 1969 through 1971 was of the order of 14.4% while the decrease in earnings by fishermen over the same period is of the order of 4.45%. Further, the increase in fish production in the period 1971 through 1977 was of the order of 29.59% while the increase in fishermen's earnings over the same period was of the order of 67.49%.

Using the statistical data for 1977 when 19,332 tonnes of fish valued at 25,681,000 shillings was landed, and assuming that the estimated number of 4599 canoes remained in use in the Kenya waters of Lake Victoria throughout the year it is culculated that each canoe landed 4.20 tonnes valued at shillings 5,584.00 in 1977. This implies worthless earnings by fishermen.

Although attempts have been made to explain this negative image by the seasonal activity of some fishermen and the free distribution of some portion of fish catches, it remains quite evident that the income of most of the fishermen in the Kenya waters of Lake Victoria is below poverty line. Whiting (1969) worked out the profit margin for most of these fishermen at between 90/= and 188/= per month.

VIII CONCLUSIONS

The contribution of fisheries to the GDP of Kenya is still fairly small. However, the impact of fisheries in providing local employment and highly nutritious, protein food is well known and appreciated by Kenya Government authorities. Throughout this paper the fishing industry in the LVB has been discussed with in-depth analyses of the patterns of fish production, management and such socio-economic factors as employment, marketing and the psychology and organization of fishermen. In the discussions emphasis has been placed on those measures that may promote the achievement of maximum sustainable yield and enhance the development of the fisheries resources to generate additional employment opportunities and increased incomes. It is thought that the implementation of the various recommendations made at the various stages of the discussions would go along way in achieving these goals.

The role of the LVBDA in the development of the fisheries resources in the LVB has not been discussed much in this paper. It should, however, be quite apparent from the discussions in the paper that the development of the fisheries resources will inevitably require the involvement and cooperation of a number of Government Ministries and agencies, and possibly in collaboration with private firms or individuals. It is, therefore my considered view that the LVBDA will have to play the dual roles of being both the "co-ordinator" as well as "Financier" of the various development programmes in the LVB in order to ascertain achievement of desired goals. The LVBDA would, in this case, provide the medium for close consultations, co-operation and collaboration between and among the various development agencies. Further, the LVBDA would, where possible and appropriate, provide the required the required finances to oil the development processes.

It was observed in the paper that Lake Victoria is trinational, being shared by Uganda, Tanzania and Kenya. Although the inshore fish populations do not tend to migrate much, changes in stock levels in one part could

easily affect those in other parts of the lake. I also tend to agree with Oyugi-Aseto (1979) that activities involving use of water in one area in the LVB could easily affect the water regime in the whole basin. It may therefore be necessary to forge a system of co-operation with the other two neighbouring states on matters of water resource utilization and management in the LVB. In the case of fisheries a system similar to the defunct 'Lake Victoria Fisheries Commission', which was established under the auspices of the defunct East African Freshwater Fisheries Research Organization, and responsible for the co-ordinated management of the fisheries resources in the LVB, would be most appropriate.

REFERENCES

Development Plan - Republic of Kenya: Fisheries and Co-operative Development; 1979-1983 Part 1: 300-324.

EAFFRO - (East African Freshwater Fisheries Research 1968-1977 Annual Reports and Occasional Reviews on Lake Victoria Fisheries.

Fish Industry Act (1968) Chapter 378; Laws of Kenya.

Fisheries Department - Republic of Kenya: Statistics and: Annual Reports. 1965-1977.

Garrod, D.J. 1951-1956. (EAFRO - East African Fisheries Research Organization) - A Review of Lake Victoria Fisheries Service Reports; Pamphlet No. 1 pp. 10.

Gee, J.M., 1969. A Comparison of Certain Aspects of the Biology of Lates niloticus (linne) in Endemic and Introduced Environment in East Africa; Man-Made Lakes: The Accra Symposium; Ed: L.E. Obeng pp: 251-260.

Obrahim t. 1975. et al,Preliminary observations of cage culture of Tilapia esculenta and Tilapia zilli in Lake Victoria at the Freshwater Fisheries Institute, Nyegezi, Tanzania. Afr. J. Trop. Hydrobiol. Fish. (Special issue 3): 121-126.

Jansen, E.G., 1973. The Fishing Population in the Kenyan Par of Lake Victoria: Report to the East African Freshwater Fisheries Research Organization. (EAFFRO). pp.

Kudhongania-Akiki and Cordone A.J.; 1974. On the Management and Development of the Lake Victoria Fisheries: Report to EAFFRO.

Kudhongania et al; 1975. Summary of IBIS Bottom Trawl Survey Results for Lake Victoria in General; Report to EFFRO.

Lowe R.H.; 1956. Observations on the Biology of Tilapia (Fixes-Cichlidae) in Lake Victoria, East Africa; East African Fisheries Research Organization; Supplementary Publication No. 1: pp. 72.

Marten G.G., Wanjala B. and Guluka L.T.; 1975. Exploratory Trawling of the Lake Victoria Fishery in Kenya during 1975: Report to EAFFRO. pp. 20.

Marten G.G., Wanjala B., 1977. Scully R.J. and Rinne J.N.; Recommendations and Research on the Fishery of Lake Victoria: Report to EAFFRO.

Mikkola H., 1978 Fisheries Co-operatives; A Survey on Potentials for Expansion and Development: A Report of the Nordic Consultant for Fisheries Co-operatives to the Department of Co-operative Development: pp. 103.

Okidi, C.O.; 1979. Kenya's Marine Fisheries: A General Outline of Policy and Activities; Institute for Development Studies , Occasional Paper No. pp. 35.

Oyugi-Aseto; 1979. The Application of the Concept of Comprehensive and Integrated Planning to the Development of Lake Victoria Basin; Institute for Development Studies, Working Paper No. 33: pp. 35.

Powell T.G.; 1977. Analysis of Nine Years of Fish Landing Data From Nine Beaches in the Kenyan Waters of Lake Victoria: Annual Report to EAFFRO.

Scully R.J., 1975. The importance of Haplochromis in Lake Victoria's gill Net Fisheries: Report to EAFFRO.

The Standard, Newspaper, Kenya. Friday, 15th September, 1978.

UNDP/FAO Lake Victoria Fisheries Research Project: 1[illegible]. Investment Proposal for a Commercial Fisheries Enterprise, Lake Victoria.

UNDP/EAFFRO The Lake Victoria Research Project; Trawling Survey: 1970. Report to EAFFRO.

Wanjala, B. and Marten G.G., 1973. Survey of the Lake Victoria Fishery EAFFRO 1974, Annual Report.

Wanjala, B. Effect of Beach Seining on the In-Shore Stocks of Lake Victoria Report to EAFFRO.

Welcome R.L.; 1969. The Effect of Rapidly Changing Water Level in Lake Victoria Upon the Commercial Catches of Tilapia (Piccs: Cichlidae): Man-Made Lakes: The Accra Symposium: Ed. L.E. Obeng; Ghana University Press.

Wetheral J.A.; 1974. On the Catch Assessment Survey of Lake Victoria. EAFFRO Occasional Paper No. 14.

Whiting, P.S.; 1969. Costing Study of a Karua Tilapia Gill-netter on Lake Victoria. EAFFRO Annual Report, 1968.

FIGURE 1

TOTAL ANNUAL CATCHES OF ALL FISH SPECIES IN TONNES [illegible]
THE KENYA WATERS OF LAKE VICTORIA IN THE PERIOD 1968 THROUGH 1977.

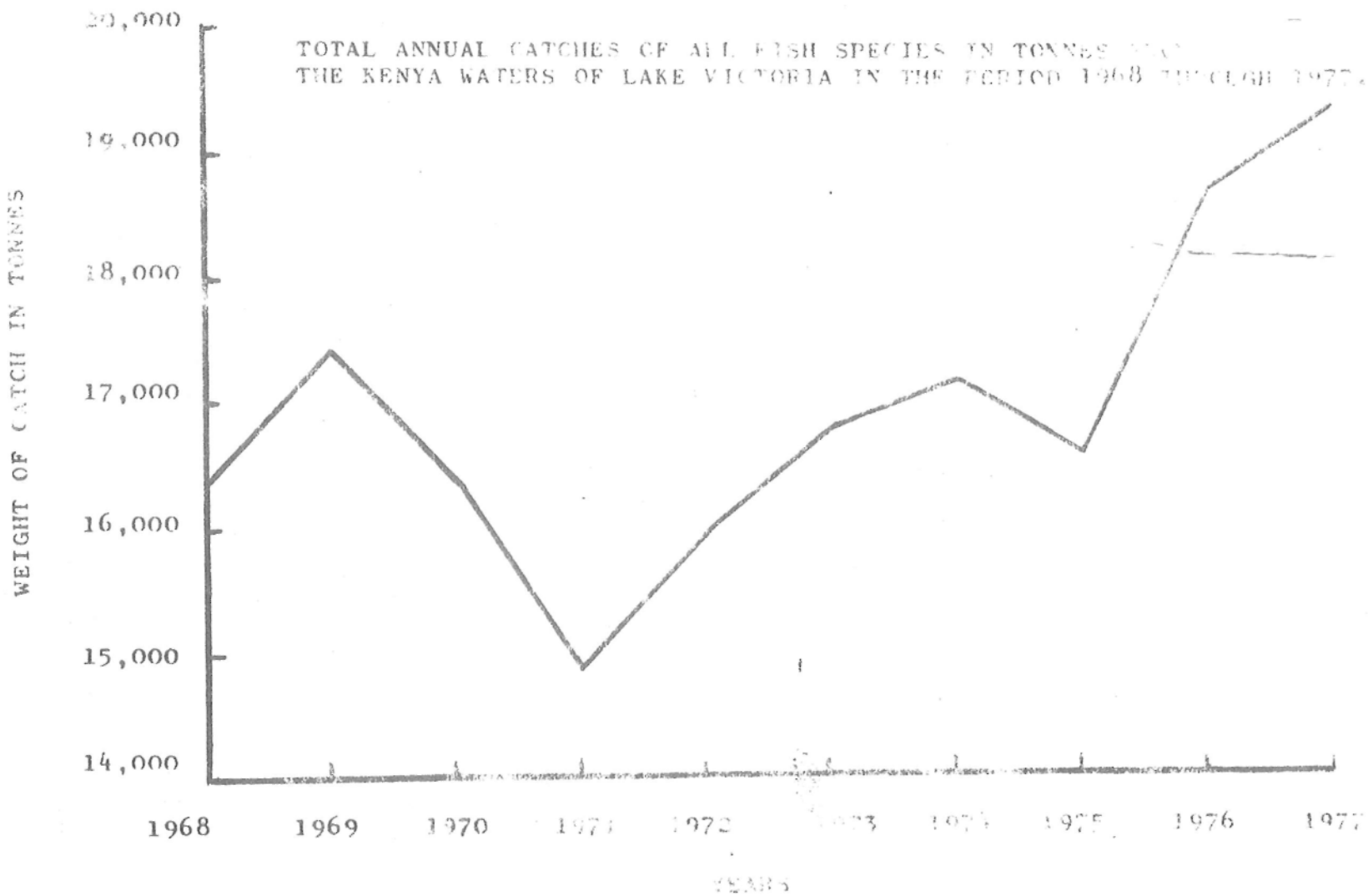


FIGURE: 2

TOTAL ANNUAL CATCHES OF TILAPIA IN TONNES DURING THE PERIOD 1968 THROUGH 1977.

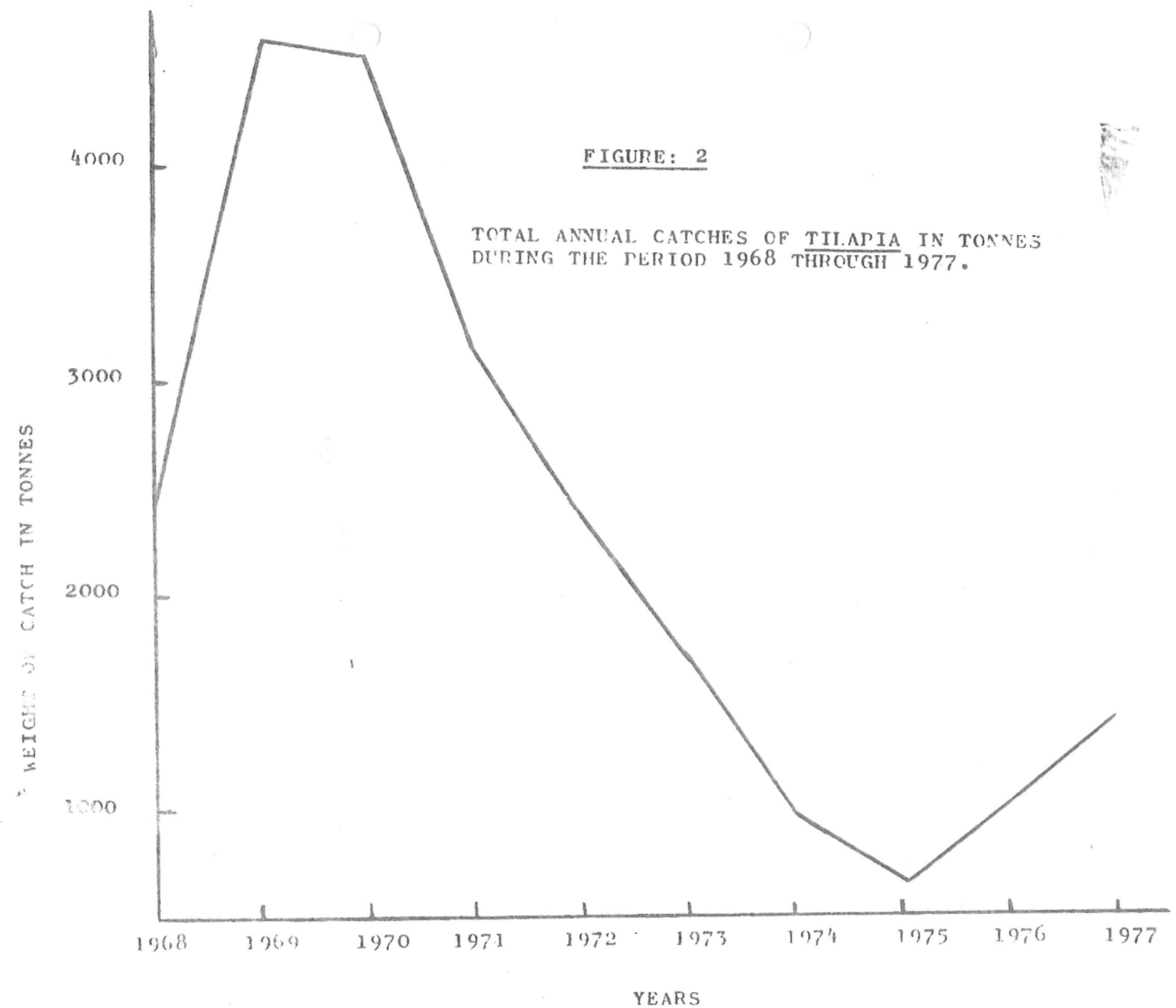


FIGURE: 3

ANNUAL PRODUCTION OF *Haplochromis* IN TONNES
FISHING PERIOD 1968 THROUGH 1977.

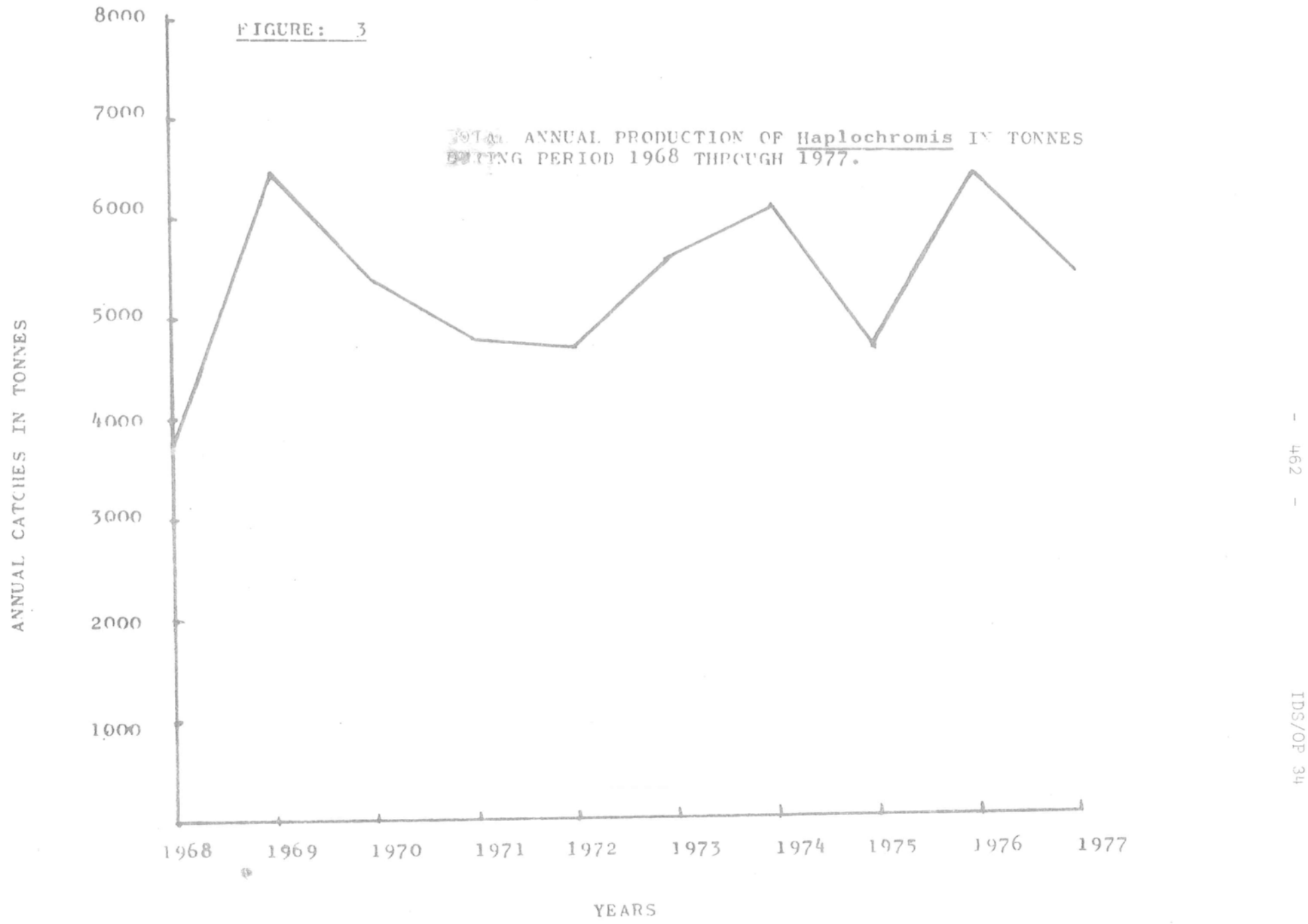


FIGURE 4

TOTAL ANNUAL PRODUCTION OF Engraulicypris IN TONNES DURING PERIOD 1968 THROUGH 1977.

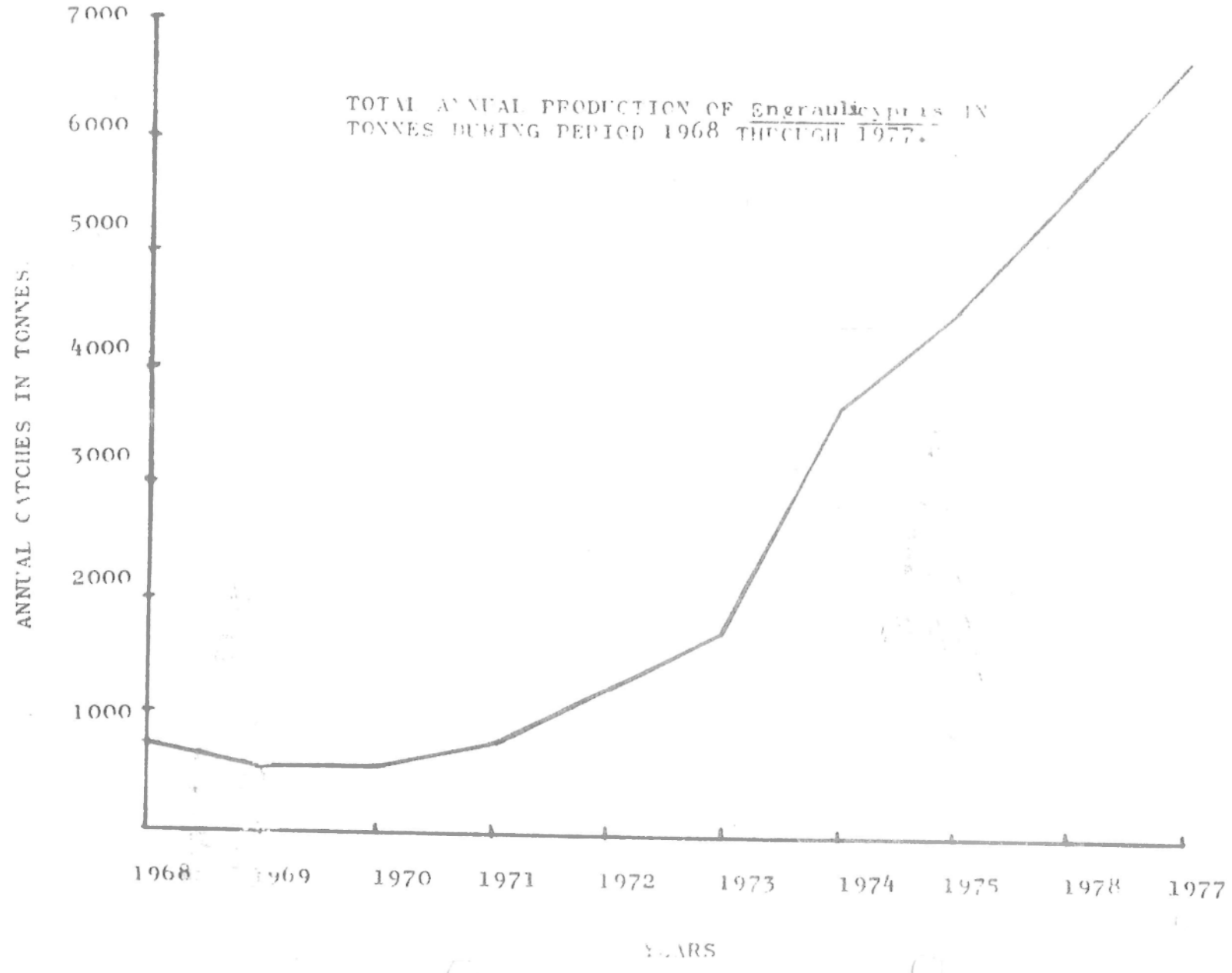
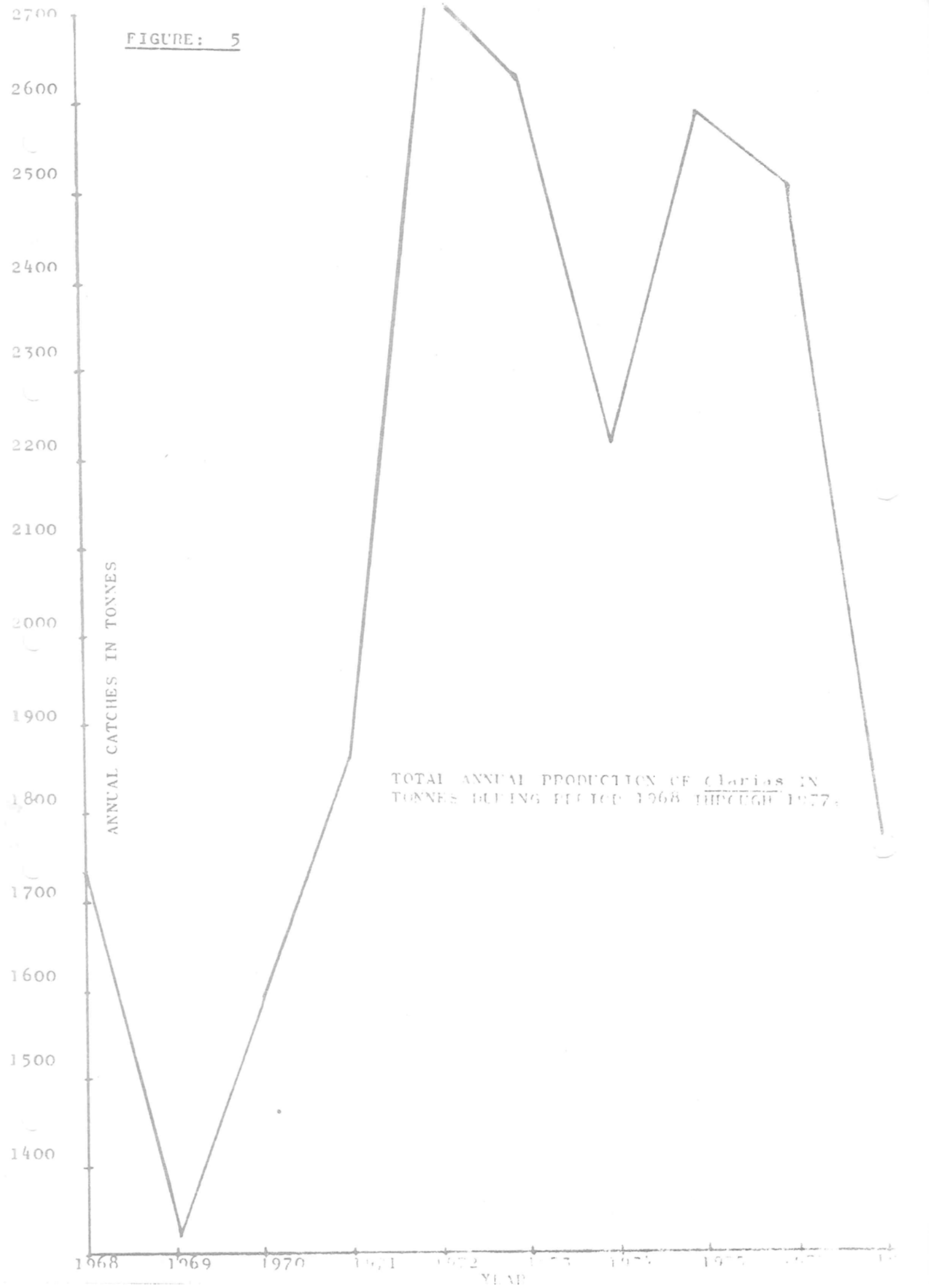
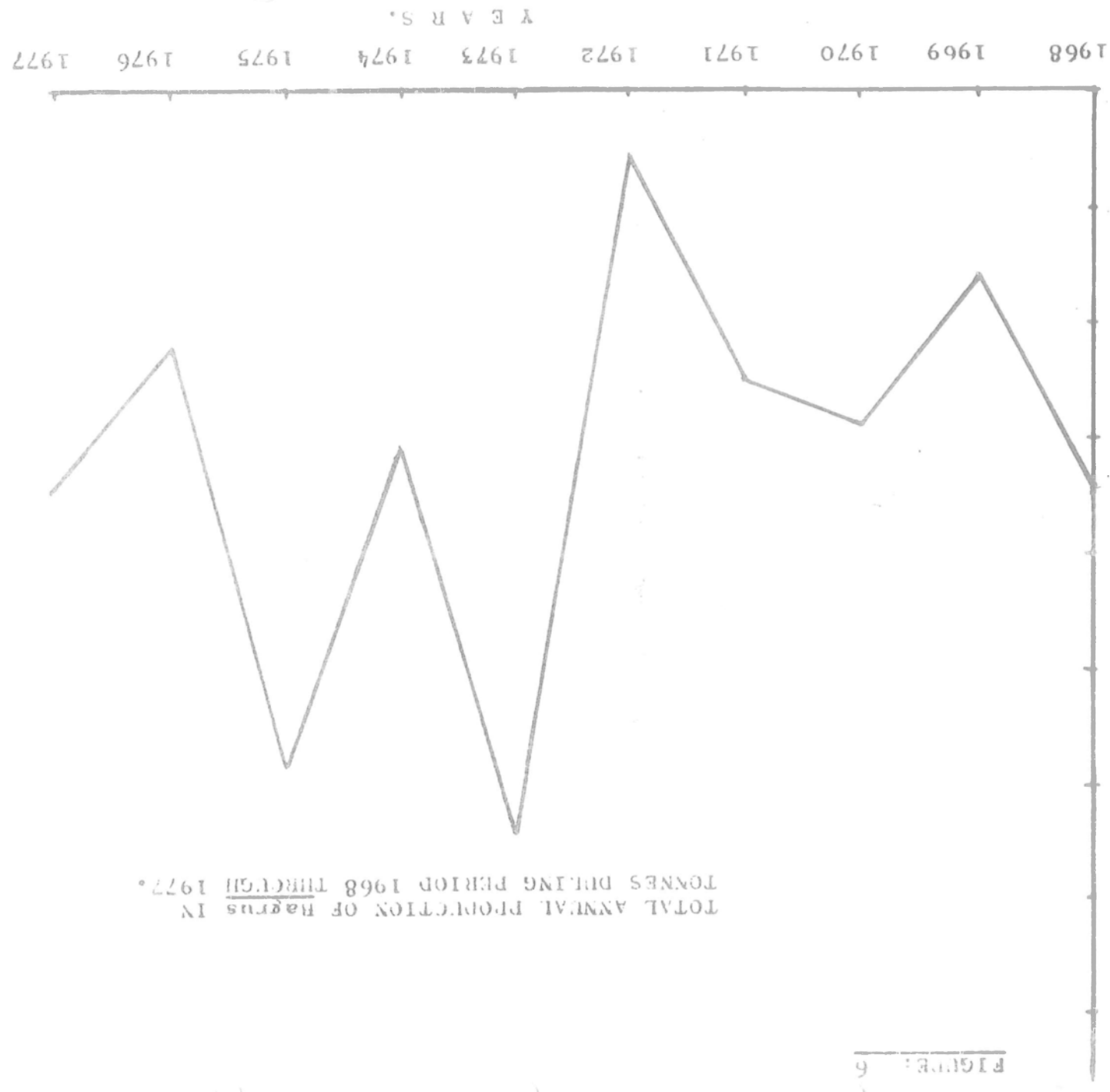


FIGURE: 5



TOTAL ANNUAL PRODUCTION OF Clarias IN TONNES DURING PERIOD 1968 THROUGH 1977.



TOTAL ANNUAL PRODUCTION OF Hagrus IN TONNES DURING PERIOD 1968 THROUGH 1977.

FIGURE: 6

IDS/OP 34

FIGURE: 7

TOTAL ANNUAL CATCHES OF Protopterus aethiopicus IN TONNES DURING THE PERIOD 1968 THROUGH 1977.

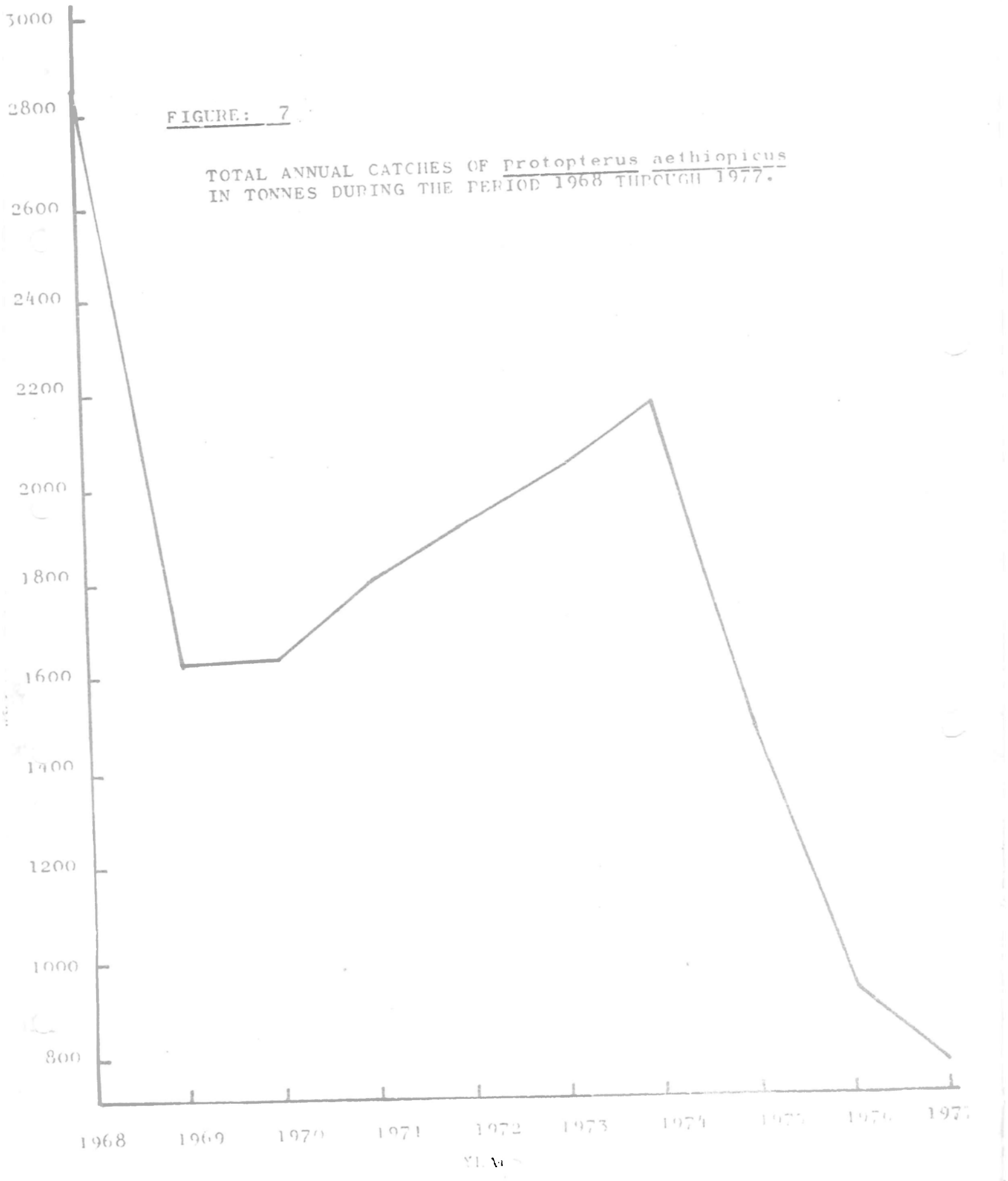


FIGURE: 8

TOTAL ANNUAL CATCHES OF *Lates niloticus* IN TONNES DURING THE PERIOD 1968 THROUGH 1977.

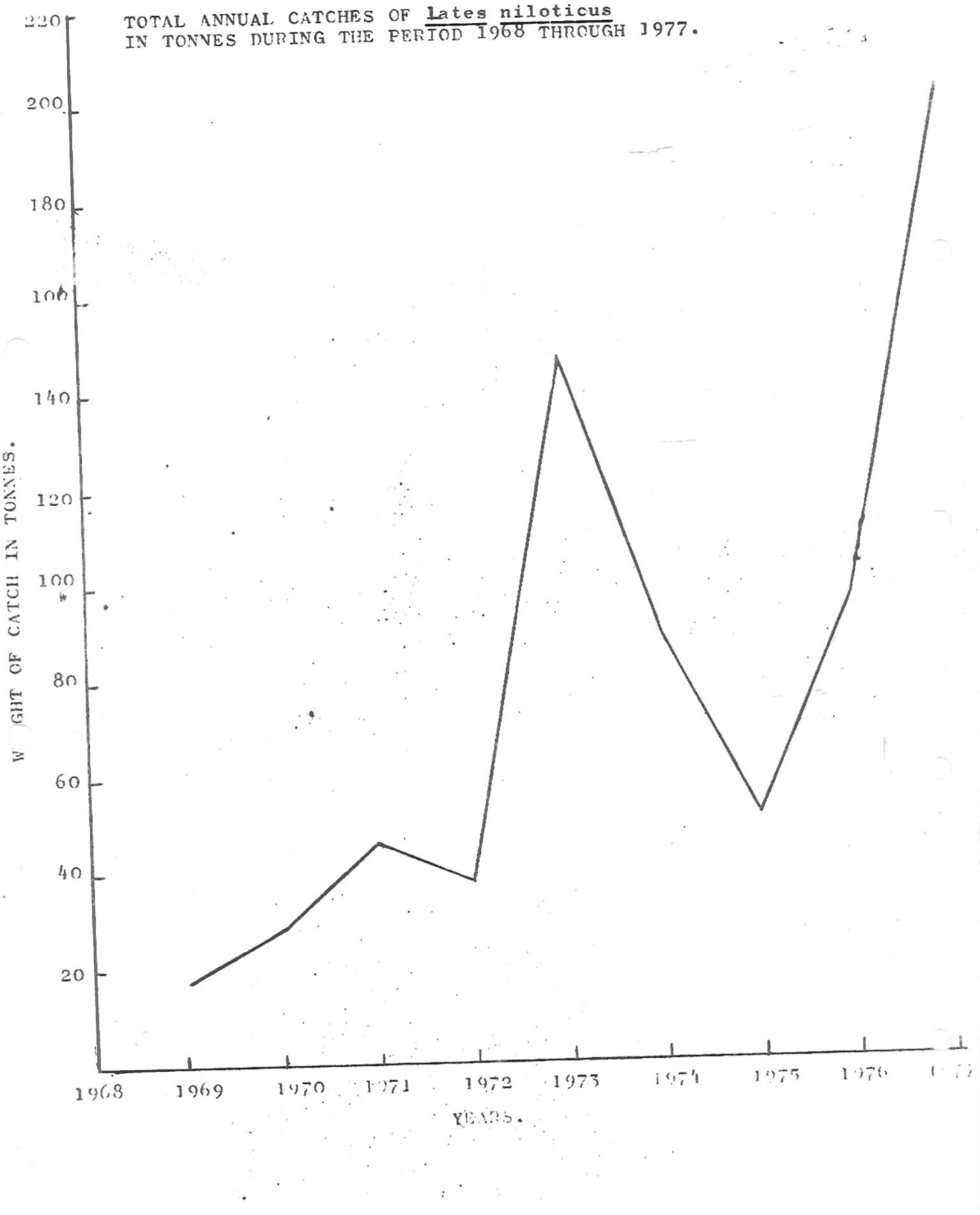


FIGURE: 9

TOTAL ANNUAL CATCHES OF Labeo IN TONNES IN THE PERIOD 1968 THROUGH 1977.

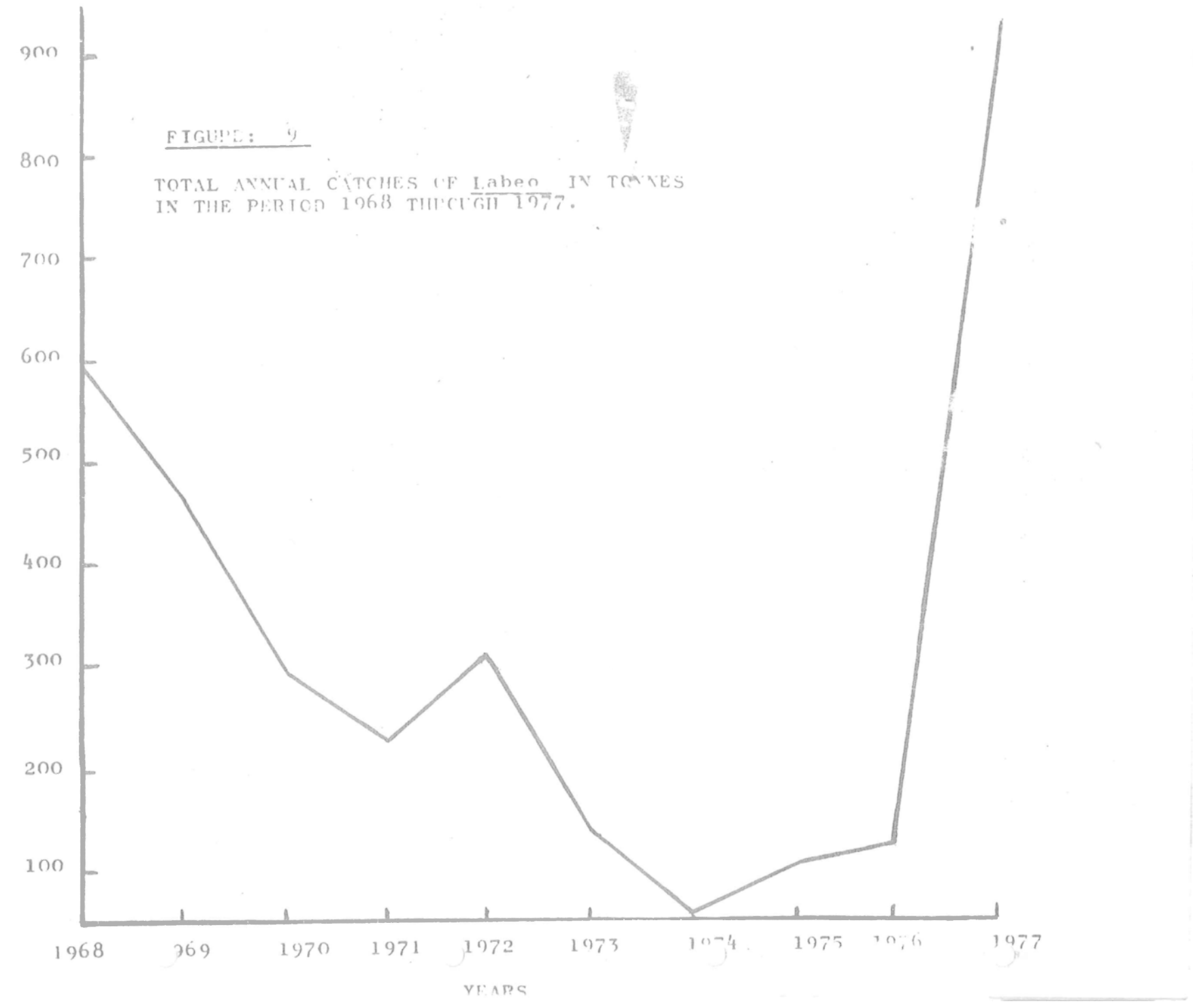


FIGURE: 10

PERCENTAGE CONTRIBUTION OF THE VARIOUS FISH SPECIES TO THE TOTAL ANNUAL CATCHES FROM THE KENYA WATERS OF LAKE VICTORIA

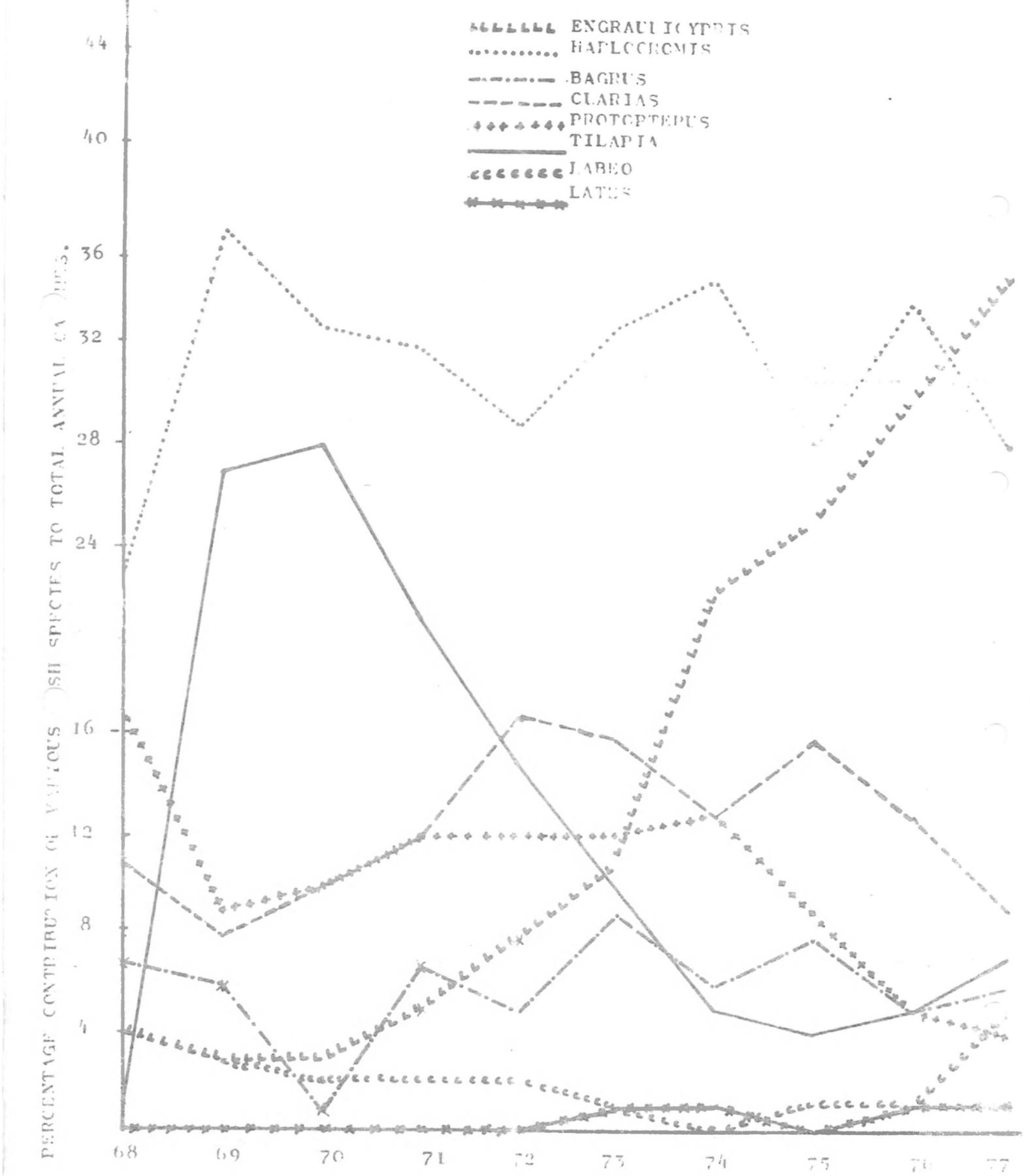
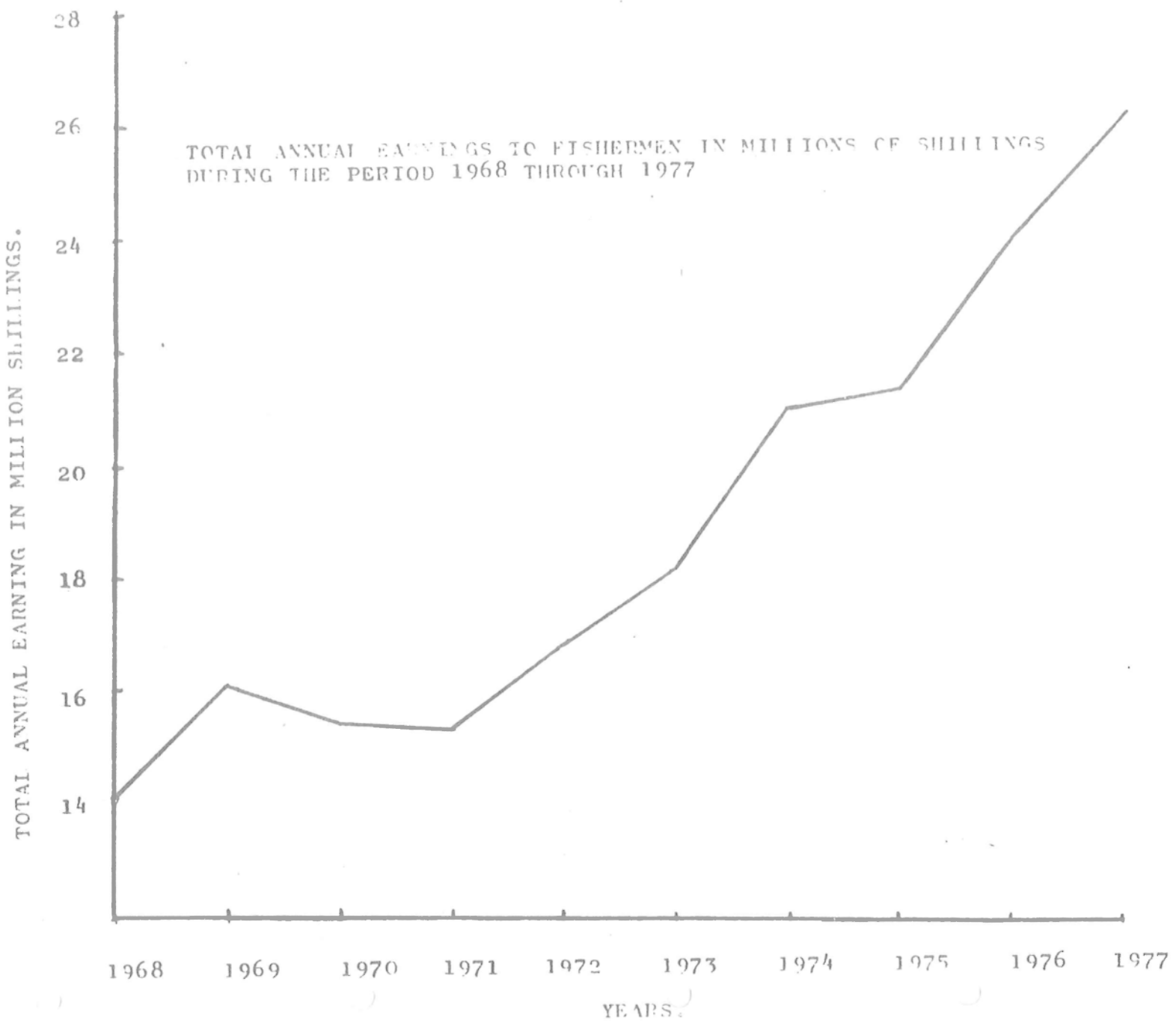


FIGURE: 11


TOTAL ANNUAL EARNINGS TO FISHERMEN IN MILLIONS OF SHILLINGS
DURING THE PERIOD 1968 THROUGH 1977
TOTAL ANNUAL EARNING IN MILLION SHILLINGS.
28
26
24
22
20
18
16
14
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
YEARS.

FORESTRY AND WILDLIFE IN THE LAKE VICTORIA BASIN

By

F. Owino
Department of Forestry
University of Nairobi.

1. Introduction

A sure characteristic of socio-economic development in the Lake Victoria Basin will be the increased usage of fibre products chief among which will be wood in its many forms. Any such development will entail concomittant increase in indigenous consumption of forest goods such as fuelwood and charcoal for cooking, heating and household uses; building poles for housing, fencing and furniture; pitsawing and sawmilling for furniture, construction and farm building. Additionally, the existing forests are expected to fall to great indigenous pressures for agricultural uses in shifting cultivation, forest grazing and apiculture.

Correlated increases in the industrial uses of forest products are also to be expected. These will include charcoal as a reduction agent in steel making and in the manufacture of polyvinyl chloride (PVC) and dry cells; saw logs for lumber, construction, joinery e.t.c.; veneer logs for plywood, veneer furniture e.t.c.; pulpwood for newsprint, paperboard, printing and writing paper.

The most critical role of forests in the Lake Victoria Basin will, however, continue to be the maintenance of ecological balances. Forests in the basin will (and must) continue to play crucial role in water catchment protection for controlled runoff, water supply and soil fertility. For the projected developments in the basin, forests must play greater roles in ecology and wildlife conservation for recreation, tourism and the protection of endangered plant and animal species. Above all, forest developments in the basin promise to play valuable role in soil erosion control as windbreaks, shelterbelts and in the reclamation of eroded lands.

2. Forests and forestry developments in the Lake Victoria Basin

2.1. Inventory of existing forests

Table 1 gives a breakdown of the existing forests within the basin.

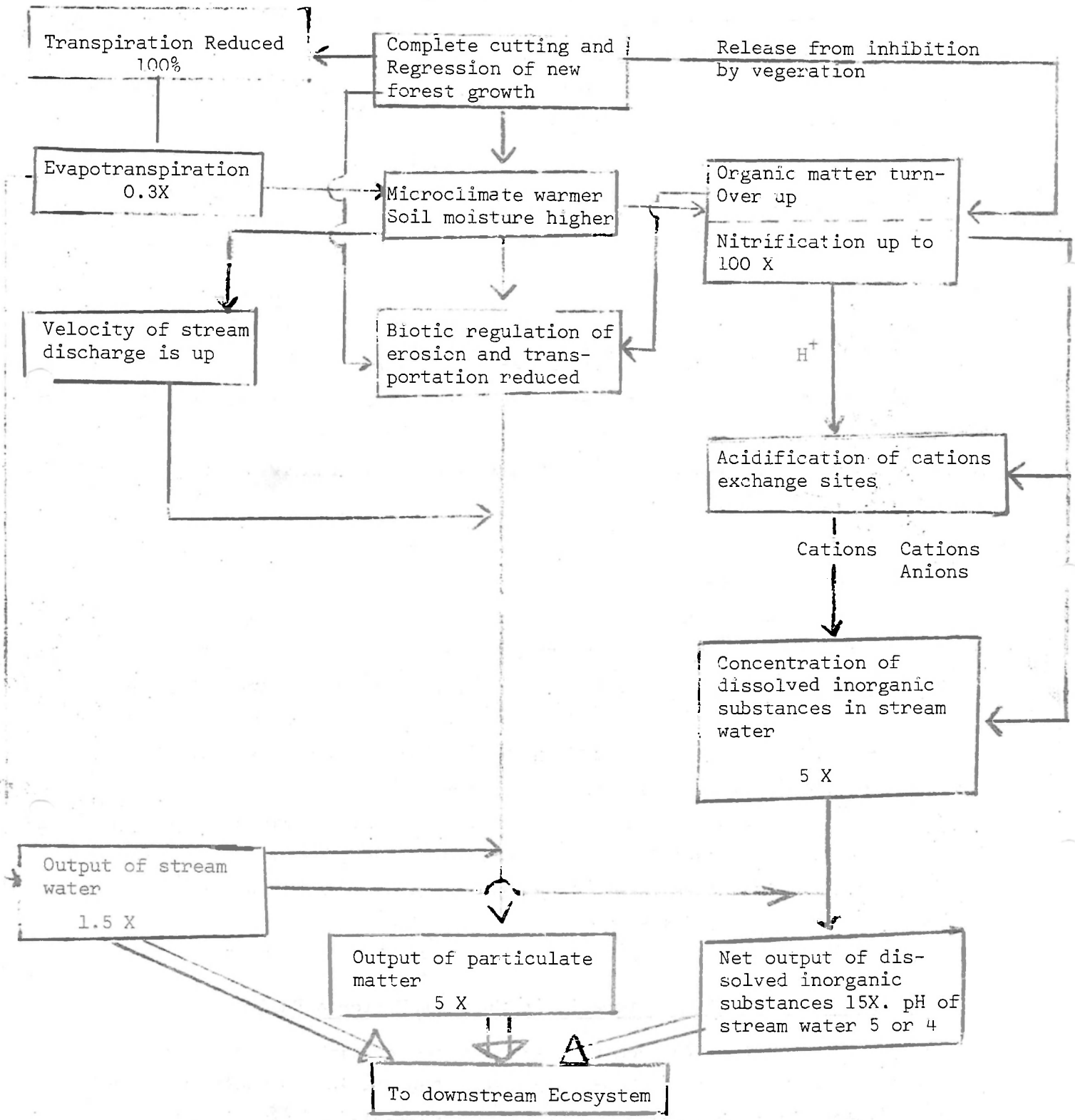
Table 1. Existing forests in the Lake Victoria Basin.

Forest	Total area (ha.)	Area under indigenous forest (ha.)	Area under exotic mono-cultures (ha.)	Area for potential development (ha)	Remarks
1. Mt. Elgon	71,351	50.945	4,281	16.125	
2. Cherangani	94,233	58,425	9,706	26,103	
3. Bunyala	825	275	550	-	Threatened to extinction
4. Malaba	719	-	-	-	
5. Kisere	487	487	-	-	Nature Reserve
6. Teressia	384	-	-	-	
7. South Nandi	19,502	9,576	3,900	6,026	
8. Kakamega	24,246	9,698	7,685	6.862	Has 2 Nature Reserves
9. North Nandi	11,354	11,354		-	Has 1 Nature Reserve.
10. Kaptario	328	-	-	-	
11. Ururu	433	-	-	-	
12. Maragoli	469	-	-	-	
13. Kapsaret	1,2[illegible]	-	-	-	
14. Kessop	2,347	-	-	-	
15. Kaptagat	16,578	912	11,057	4,608	
16. Kipkabus	5,010	1,357	2,274	1,367	
17. Timborca	5,891	-	-	-	
18. Nabkoi	3,041				
19. Tinderet	27,869	19,437	8,999	-	
20. West Mau	19,833	-	-	-	
21. S. West Mau	86,870	-	-	-	Big Nature Reserve
22. Chepalungu	10,187	10,187	-	4,523	

The existing forests in the basin occupy a total area of some 430,000 ha. This estimate excludes small forests on hilltops like Got Ramogi, Kodera forest, Lambwe e.t.c. Lake Victoria Basin forests thus constitute about 25% of the total existing Kenyan forests rendering service and providing goods for about 60% of Kenyan population.

Forest Reserves within the basin include Kisere (487 ha.), Yala (469 ha.), Kakamega Forest Station (210 ha.), South West Mau (43,032 ha.) and North Nandi (3,434 ha.) These reserves are areas within which no form of disturbance or forest management is allowed - by government gazetting.

Figure 1. Ecological inbalances following large scale deforestation



Apart from the above areas, the indigenous forest base has been and continues to be subjected to both destructive and constructive management. In a few areas, the forests are wisely managed for sustained yield of valuable timber by selective felling. In most of the cases, however, these forests are facing increasing agrarian-motivated decimation. For example, Owino et.al. (1979) have estimated that during the last three years, 17% of North Nandi forest and over 25% of Kakamega forest was destroyed by unwise shifting cultivation practices.

Another issue worthy of immediate review concerns the proportion of the indigenous forest base which is gazetted for future development (see Table 1). Forests like Tinderet, Kaptagat and Kipkabus have large proportion gazetted for future development. Such development will most likely take the form of compensatory forestry with exotic species. Such developments will radically change the floristic complexity and may greatly affect the catchment capacity of watersheds.

2.2 Land stablizing effect of soils

It has already been stressed that crucial role of forests in the basin will continue to be ecological stablization. The ecological inbalances upon large scale deforestation is schematically shown in Figure 1.

The detrimental effect of deforestation in the basin on stream discharge, soil erosion and quality cannot be overstressed realizing that this zone is characterised by high day temperatures and heavy stormy precipitation. Reforestation and afforestation should revert the trends but it must be realized that proper balances take a long time to establish. Immediate corrective action is therefore called for.

2.3. Water catchment role of forests in the Lake Victoria Basin.

Throughout Kenya, the dominant land use policy with regard to forests is conservation for water catchment purposes. Forests in the basin form catchment areas for the rivers which flow into Lake Victoria as shown in Table 2.

Table 2. Total forest area in each river catchment in Lake Victoria Basin

Catchment	Forests	Total area (ha.)	% of total basin forest area
Nzoia Sio	Elgon Kaptagat Cherangani Kessop Kipkabus Kakamega Kaptaroi	214,095	50%
Yala	South Nandi North Tinderet	45,652	10%
Kibos	South Nandi	19,502	4.5%
Nyando	North Tinderet Tinderet West Mau	73,853	17%
Sondu	West Mau South West Mau	106,703	24%
Kuja	Kisii Highlands	-	-
Migori	Chepalungu	10,187	2%

It is to be noted that out of the 430,000 ha. of forests in the basin, about 410,000 ha. of forests contribute directly to river catchment. Thus only about 6% of the existing forests in the basin does not contribute to river catchment. This underscores the importance of catchment-sensitive forest management and research within the lake basin.

2.4 Forest base for domestic wood consumption

With the ever increasing cost of fossil fuels, it is important and a matter of urgency to plant trees within the basin for domestic wood consumption mainly for fuelwood and charcoal. It is estimated that, nationwide, it is necessary to plant about 5 million ha. of fast-growing exotic tree species in order to attain self-sufficiency in domestic wood consumption. Lake Victoria Basin alone would require additional planning of some 2 million ha. forest plantation for fuelwood and charcoal for domestic consumption. This represents a very large portion of land locked up for energy requirements for a very densley populated region of Kenya. It is therefore imperative that afforestation and reforestation schemes within the basin for energy requirements be supplemented by other schemes like hydropower generation for energy sufficiency within the basin.

Nevertheless the point still holds that a family of 5 uses about $2m^3$ of firewood per month. The fastest growing tree species can yield close to 42,000 m^3/ha/rotation over rotations of 5 to 6 years. Fast-growing species like Eucalyptus tereticornia and Cassia siamesa could be grown easily for this purpose. The action required is to advise families to plant small woodlots for their own fuelwood requirements. It is further essential that some format for sustained yield be instituted. Since sustained yield planting and management requires areas above the general family land holding capacity, it may be necessary that some communal basis be instituted for sustained yield purposes. For example, if five families get together so that each family plant 0.4 ha. in staggered pattern, sustained fuelwood yield can be maintained particularly with coppicing species. It is realized that 0.4 ha. is a lot of land to spare for energy production in most parts of the basin. However, if one combines fuelwood production with the necessary windbreak, shelterbelts and fences, that kind of land required is not beyond most families.

2.5 Forest base for industrial wood consumption

About 1/5 of forest area within the basin is planted with fast-growing exotic tree monocultures to provide the needed timber for poles, sawlogs and veneer logs. Another 1/6 of the existing forest area is earmarked for future plantation development. On the higher slopes plantations of largely Cupressus lusitanica, Pinus patula and Juniperus procera are found. On lower slopes and on the plains, the main plantation species include Eucalyptus spp. The industrial developments in the basin will require

accelerated production of timber from such plantations of fast-growing species which attain the same volume productivity in thirty years what can be achieved by one hundred and twenty years of growth of indigenous species.

It cannot be overemphasized that, in order to realistically conserve the existing forests, there is an urgent need for accelerated compensatory forestry practices on the highland sites.

2.51 Pulp and paper industry

The Pan Africa Paper Mills at Webuye is designed to use largely softwoods for pulp and paper making. A nucleus plantation is coming up at Turbo largely of Pinus patula to supply this mill. Although an extensive scale of planting (about 6,000 ha. per annum) till 1983 was planned for Turbo Scheme, it is now clear that the Kenya Forest Department is falling far short of target. The obvious consequence of this will be that softwoods will be extracted from longer distances to the mill at Webuye. Logging for the mill is already taking place in Kaptagat forests and is expected to extend to other Lake Victoria Basin forests. This extraction of wood into pulp and paper mill can only take away from sawlog and veneer log potential. This therefore calls for accelerated monoculture development.

2.52 Saw-milling industry

All over the basin, there is a rapid change from mud houses to stone or timber prefabricated rural housing. The towns within the basin are growing albeit at a slower pace as compared to other regions of Kenya. Kisumu and Kakamega for example are experiencing rapid growth in housing. These developments have entailed a sharp increase in demand for sawlogs and veneer logs. To meet this demand, an accelerated planting of Cupressus lusitanica and Pinus patula should be carried out within the existing forest areas

2.53 Tobacco industry

Current agricultural developments within the basin include large scale tobacco growing in South Nyanza district and in Western Province. This development will require a large wood base for curing process. Arrangements have been made to provide individual farmers with eucalypt seedlings for planting in small woodlots. However, the present rate of tree planting in these areas is barely enough for future domestic fuelwood consumption. There is a need for large scale planting of eucalypts on hill top for tobacco curing process. Research on the most appropriate species and provenance for these

tobacco-growing areas should be carried out as a matter of urgency. Focus should be drawn both on the growth rate and the quality of tobacco since use of different tree species result in different tobacco qualities out of the curing process. A plausible line of action would be to develop a hybrid Eucalyptus tereticornis x E. camaldulensis which combines the fast growth rate of E. tereticomis with the drought hardiness of E. camaldulensis.

2.6 Agroforestry development in the Lake Victoria Basin

Because so many live and depend on a relatively small land base within the basin, it is necessary to harmonise agricultural production with forestry activities. Agri-silvicultural practices like the 'taungya' system is practised in some forests within the basin. According to such systems, workers grow agricultural crops while weeding the tree crop for two or three years. On a larger scale, agri-silvicultural practices within the basin include sugar cane growing on the grass glades within Kakamega forest.

A further stage of development should be agroforestry practices whereby trees are not only grown for the traditional uses but also as fodder crops. Several tree species have already been identified for such dual purpose e.g. the indigenous Acacia albida and the exotic Leucaena leucocephala. The foliage of such species make good livestock fodder and the trunks can be used for fuel or building. An additional advantage of growing such trees is that, being nitrogen-fixing species, they greatly improve the quality of the soil on which they are grown.

Since livestock nutrition is so poorly developed, farmers should be encouraged to grow trees which will not only provide them with fuel but which will also enable them to raise more and healthier livestock. For such developments, fodder varieties of L. leucocephala should be the starting point.

2.7 Present constraints in forestry developments within the Lake Victoria Basin.

The Kenya Forest Department through its Rural Afforestation programme is already providing seedlings for planting of woodlots from their nurseries at Kakamega, Maseno, Migori, Siaya, etc. Individual farmers are readily taking advantage of this service. However, the scale of tree planting within the basin is still very small as vis a vis future domestic wood demands. Furthermore, off-site plantings and poor husbandry contribute significantly to failures in this programme. There is a yawning gap in research and operation with respect to rural afforestation within the basin.

2.71 Nursery development

The present Forest Department nurseries within the basin have the potential of combined annual output of some 2,000,000 seedlings. The proposed forestry developments as proposed in this paper call for an annual nursery output of nearly 10,000,000 seedlings. There is therefore a need to establish at least 5 more nurseries within the basin. Seedling outplanning from the nursery is a delicate operation and, whenever possible, seedling movement distances should be minimized. Nursery siting must therefore be done with ease of distribution in mind.

Nursery-oriented research should be embarked on. Such research should concentrate on (i) optimal soil mixture, (ii) most appropriate watering regime, (iii) potting methods and (iv) optimal outplanting age.

2.72 Catchment research

As has been stressed in Section 2.3, the catchment role of forests within the basin is critical to agricultural development and flood control. , in order to meet the future increased timber demands, some form of management must be carried on these catchment forests with a view of increasing their timber productivity. Contemplated and present management systems include compensatory forestry and selective felling together with some enrichment planting. These forest management systems will have important effects on water quantity and quality. Research must be immediately established to determine forest managements systems most compatible with the stated catchment roles.

2.73 Species and provenance research

The key to any sound afforestation programme is the start with most appropriate species and provenance of the species for the region of interest. To date, very little research has been done - with this objective - within the Lake Victoria Basin. Several species of eucalypts and Grivellia robusta should be tried. The criteria for selection should include fast growth, resistance to water stress and little genotype environment interaction.

3.3 Distribution of known large mammals

The distribution of large wildlife mammals is shown in Table 3.

Table: 3 Distribution of large wildlife mammals within Lake Victoria Basin

Masai Mara	Mt. Elgon	Lambwe Valley	Saiwa Swamp	Cherengani
Hunting dog***	Elephant**	Spotted hyena**	Sitatunga*	Elephant**
Spotted hyena***	Impala*	Leopard**	Buffalo*	Warthog*
Stripped hyena***	Topi**	Warthog*	Warthog*	Bush Pig*
Lion***	Blue Diuker*	Defassa		Rothchild's Giraffe***
Leopard***	Oribi*	Roan Antelop**		Bushbuck***
Cheetah***	Buffalo*	Impala**		Impala**
Elephant***	Blue Monkey**	Jackson's harvebeest***		Buffalo**
Plains Zebra***	Olive baboon**	Topi***		
Black Rhinoceros***	Colobus Monkey***	Oribi**		
Hippopotamus**	Giant Forest hog*	Buffalo**		
Warthog**	Bush pig*			
Giant Forest hog*	Waterbuck**			
Masai Giraffe***				
Eland***				
Bushbuck***				
Defassa Waterbuck***				
Roan antelope**				
Reed buck*				
Impala***				
Grant's Gazelle**				
Thomson's Gazelle***				
Wilderbeest***				
Topi**				
Cook's Hartebesst***				
Oribi**				
Klipsoiger*				
Steinbok*				
kirk's dikdik***				
Buffalo***				
Bush pig*				

Notes: * Rare
** Common
*** Abundant

Source: Report of the Working Group on the distribution and status of East African Mammals, East African Wildlife Society (1977).

Masai Mara is far superior in wildlife diversity and abundance. It is also the most tourist favoured park in Kenya. Lambwe Valley National Reserve is one of the very few habitats for Roan antelopes.

3.4 Bird life in the Lake Victoria Basin

Kakamega and Nandi forests are famous for bird life. About 144 different bird species have been identified and about 20% of these are unique to this area and do not occur anywhere else in Kenya. The Swamps around Lake Victoria are popular nesting ground for most birds and should be conserved for that purpose. For bird watchers and naturalists, there is no better place than the Lake Victoria Basin not only because of local bird life diversity but also transient birds from Uganda.

3.5. Tourism in the Lake Victoria Basin

Tourist flow within the basin is shown on Table 4.

Table 4. Tourist flow (absolute number of visitors/year/park)

Park/Reserve	No. of visitors							
	1971	1972	1973	1974	1975	1976	1977	1978
Mt. Elgon	1398	3773	4168	3707	2250	-	2782	2634
Masai Mara								39,881
Saiwa Swamp						1,853		
Lambwe Valley)								
Ndere Island) Negligible								

Source: Economic Survey 1978. Ministry of Finance and Planning.

2.74 Manpower requirements

At present, Kenya Forest Department staff stationed in the basin are very few and widely scattered. There is a Divisional Forest Officer stationed in Kisumu and 10 foresters in-charge of the various forest stations within the basin. As an example of how inadequate the present staffing is in the basin, let us consider Kakamega Forest Station. This station is maned by one Forester, 2 Assistant Forester, 22 Forest Guards and a Nursery forces of 12 men. This is the only manpower available and yet it has the huge task of performing forestry operations in Kakamega, Yala, Kisere and Malaba forests. The situation is worse in other forest areas. It is estimated that, in order to accomplish the proposed accelerated forest development within the region, an additional employment of at least 5 Foresters, 30 Forest Guards, 10 Nursery Foremen and at least 100 Nursery workers would be necessary.

It is also essential to employ a research specialist (Silviculturist) to plan and co-ordinate forestry research and operation within the basin.

3. Wildlife resources in the Lake Victoria Basin

3.1. Preamble

Forests play a vital role in wildlife conservation and therefore developments in forestry and tourism sectors within Lake Victoria Basin must be integrated. Mt. Elgon National Park and Kakamega forests are important both from forestry and tourism aspects. Even within wildlife bases on the plains like Masai Mara National Reserve, patches of the tall Diospyros-Warbugia forests and the lower croton dichogamous forests are found. These are the favoured habitats for certain wildlife species and the forests must be conserved for that purpose.

3.2. Inventory of wildlife areas

National parks within the basin include Mt. Elgon National Park (16,900 ha.), Saiwa Swamp National Park (190 ha.). National Reserves within the basin include Masai Mara (167,300 ha.) and Lamwe Valley (30,800 ha.). Also currently under consideration in this category are Ndere Island, Kit Mikai and Cherangani. National sanctuaries within the basin include Malaba, Nzoia delta, Simbi Lake and Oyugis. Archeological Reserves have been established at Mariwa and Got Imbo.

By far the highest tourist visits are made to Masai Mara. Mt. Elgon has attracted a steady flow of tourists since 1971. Modern hotels in Masai Mara, Kisumu, Kakamega, Homa Bay have been built or are in the process.

3.6 Suggested future tourism developments in the Lake Victoria Basin.

Due to the recent border strain with neighbouring countries, Kenya has resolved to broaden its own tourist attraction the most important of which will involve opening up of the West Kenya tourist circuit. To this end certain important developments as discussed below must be undertaken immediately.

3.61 Proper siting of hotels and lodges

So far most tourist hotels within the basin occur in towns - often far away from the actual attractions. There is a need to build hotels and lodges on actual sites of attraction. Yachting on the lake should be greatly improved and other amenities like golf ranges should be included in future hotel plans.

3.62 Communication

In general, roads within the basin are relatively poor. Roads linking tourist attractions within the basin are particularly bad. During the rain season for example, roads to Mt. Elgon Park, Kakamega forest and Lambwe Valley are rendered near impassable. Investment in good roads within the basin will help increase tourist flow.

3.63 Diversification of Wildlife

There is a need to diversify wildlife in some reserves so that they could be of greater appeal to tourists. For example, introducing Chimpanzees into Kakamega forest could turn it into a more popular tourist resort. More wildlife species should be introduced into Lambwe Valley.

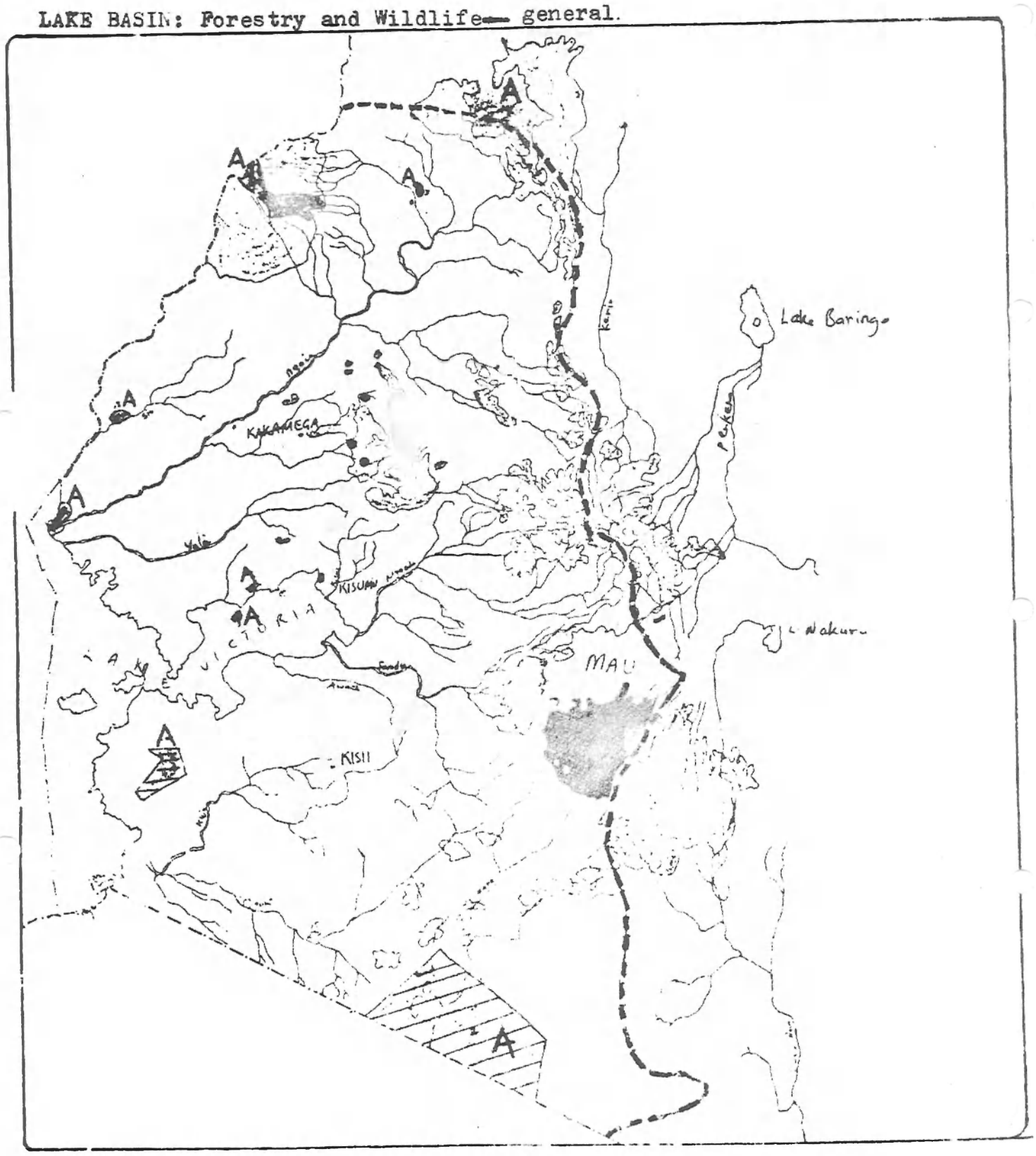
3.64 Manpower requirements

The suggested developments will require restructuring of park/reserve administration within the basin. At the moment, the overall warden for the whole region is stationed at Nakuru. There is a need to employ 2 game wardens and several game scouts in the region.

4. Acknowledgements

I wish to thank Mr. N. Ochanda for his help in sorting out some of the background data, the Director, Wildlife Conservation and Management of Ministry of Tourism and Wildlife and the Chief Conservator of Forests for the valuable information which they made available.

LAKE BASIN: Forestry and Wildlife— general.



key

River

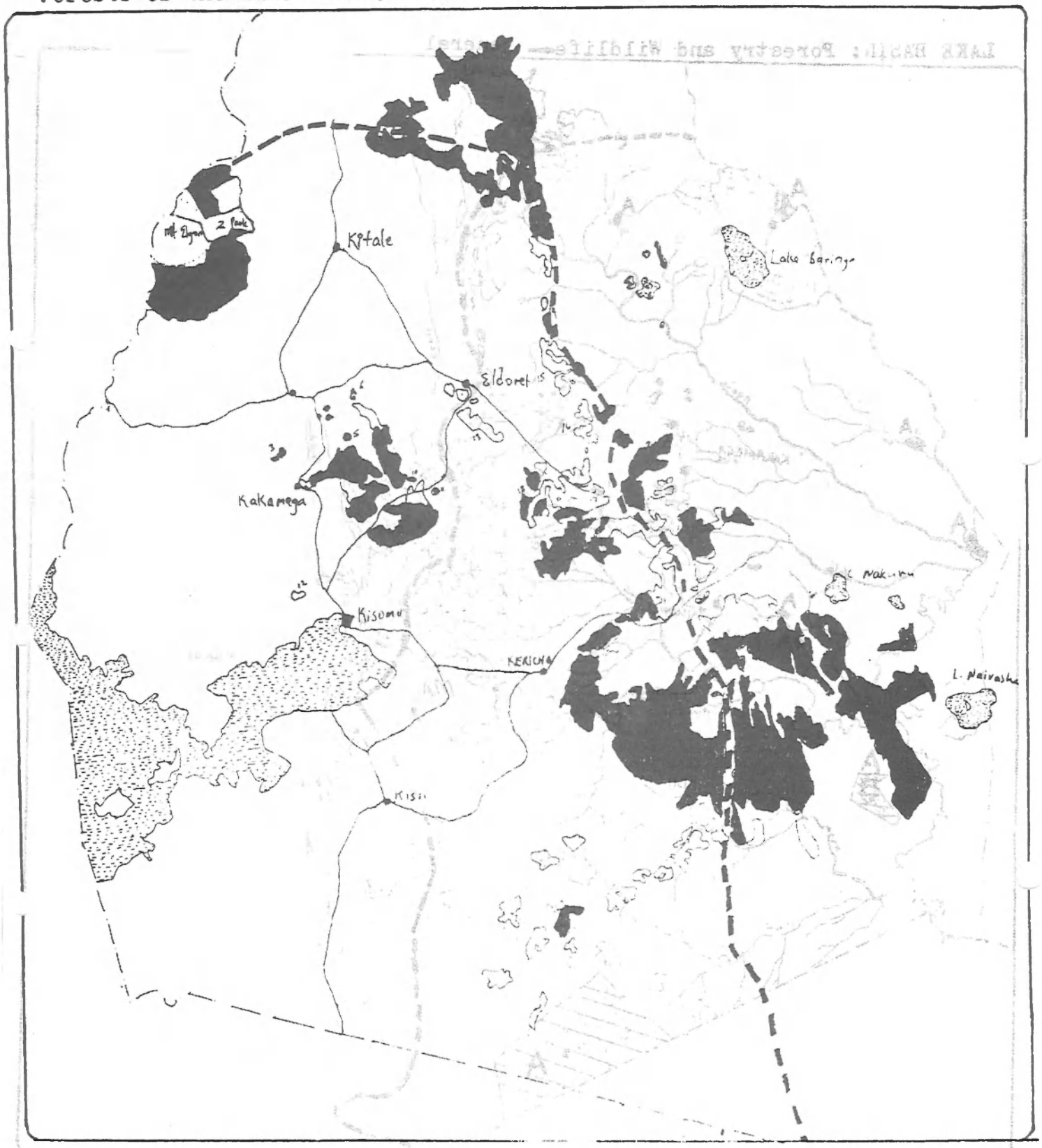
Watershed

Forest Reserves

Forest

A — Lake / present & future

Forests of the Lake Basin.



THE APPLICATION OF THE CONCEPTS OF COMPREHENSIVE AND INTEGRATED REGIONAL PLANNING TO THE DEVELOPMENT OF THE LAKE VICTORIA BASIN

By

Oyugi Aseto

Senior Lecturer
Dept. of Economics
University of Nairobi

1. INTRODUCTION

During his historic visit to Nyanza Province on the 16th December, 1978, President Moi proclaimed the creation of Lake Victoria Basin Development Authority. The visit was historic not only because it had been about ten years since a President visited the Province (the last visit was in 1969), but it was also memorable in that the crowd that turned out for the occasion was perhaps the biggest one ever in the area. The announcement was greeted with deafening cheers from the crowd. This elation was enhanced when the President directed the Minister of Planning and Community Affairs, Dr. Robert Ouko, to work out details of and programmes for the proposed authority. He is to collaborate with the Vice-President and Minister of Finance, Mr. Mwai Kibaki. Thus, for the first time in the history of the Province, an expectant crowd was given an appropriate Presidential gift at the right time. The cheers on the people's faces were a testimony to the depth of appreciation of the gift.

The significance of this proclamation cannot be overemphasized. In the first place, for the first time in the history of the area, a regional development authority was created. Of course, in the past, there have been various plans on drainage problems, on irrigation of limited areas, and on industrial development. But these were small-scale efforts to deal with regional problems on an isolated and individual basis. A regional development authority would have the capability to plan and develop comprehesively on an overall basis, it would also investigate the water and other resources endowments on a long term perspective. In the send place, the choice of the two powerful Ministers to spearhead the development of the proposed authority symbolised the weight attached to the directive. Indeed, the President's bold move, if successf implemented, has the potential of literally transforming the region from a backward area into a prosperous one.

II. THE IDEA OF WATER BASIN DEVELOPMENT AUTHORITY

The idea of promoting social and economic development of a water-basin region through a development authority is not new. Indeed, we live in the age of regional, national, or multinational development authorities based on the existence of water resources. Several cases of such water basin based authorities abound in the world. A good example of a successful water basin development authority at a national level is the Tennessee Valley Authority along Tennessee River*. We can learn, from this authority, a lot of good lessons: how to harness water basin resources and transform the region into a prosperous area. Elsewhere in the world there is the Mekong Delta Authority in Asia. This authority involves several nations which lie along the Mekong River. From their experience, we can learn the value of multinational cooperation in regional development efforts. The Treaty for Amazon Cooperation was signed on the 3rd July, 1978, by Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Surinam and Venezuela*. The chief aim of this Treaty is to promote the overall development of the territories by and/or through which the Amazon River passes. I believe that we can also learn a lot of useful lessons from these continentally famous projects.

Within Africa, similar efforts are being made. Recently, Rwanda, Burundi and Tanzania signed a treaty aiming at the joint management and development of the Ka era River Basin**. The longterm purpose of the treaty is to promote the joint development of the area's agricultural potential, of fisheries, animal husbandary and tourism. In West and Central Africa, regional development efforts include the Chad Basin Authority, Niger River Commission and Senegal Basin Development Authority (see Louis Sohn, Basic Documents of African Regional Organizations, Vol. III, New York, Dobbs Ferry, Oceana Publications, Inc. 1972). And Sudan has recently proposed the construction of the Jonglei Canal*** which has important implications for socio-economic development for the region.

Kenya has also had her share in the idea of development through water basin development authority. The Tana River Development Authority was established by an act of Parliament in 1974 (The Tana River Development Authority Act 1974, No. 7). So far, it is the only major regional development

---

*(See International Legal Materials, Vol. XVII No.5, September, 1978).

**(The Standard, Nairobi, November 9th, 1977, p. 4).

***(Weekly Review, April 28, 1978, p. 24)

authority which is operational. The terms of reference of this Authority are in Appendix I. The other development authority, which is still on the drawing boards, is the proposed Kerio Valley Development Authority. The proposed terms of reference of this authority are almost similar to the ones of the Tana River Development Authority, and are set in Appendix II. And now there is the proposed Lake Basin Development Authority. The Kenya Parliament has now approved the proposed terms of reference legally establishing the two authorities. In addition, the Parliament has allocated small sums of money (£50,000 during the 1978/79 and £200,000 during the 1978/80 financial years) to finance the necessary requirements for office space initially. These water basin development authorities clearly usher Kenya into a new stage of development effort, which require new perspectives and approaches as to policy and implementation.

While it is abundantly clear that there is a need for regional development based on water resources, it is not equally clear how to approach such a development. From a careful examination of the terms of reference of the Tana River Development Authority as well as of the Kerio Valley Development Authority, it appears as if there are bureaucratic steps through which the development authorities must go before effecting any decisions. Moreover, it seems as if there are far too many Ministries involved in the operational aspects of these development projects. No doubt, the existence of such factors will cause inefficiencies and unnecessary delays in the execution of decisions. The best approach is to give responsibility and mandate to the development authority to make and immediately execute decisions, without unnecessary interference from government Ministries.

Such an approach has several advantages. First, it enables the authority to engage in immediate and long-term planning for the region. Secondly, it gives the authority the ability to work out a systematic development programme for the area. A good systematic plan avoids haphazard and *ad hoc* decisions. Thirdly, it enables the plan programmes to be less vulnerable to the whims of political changes and thus ensures some modium of permanency of development of the area. Finally, it places the development efforts in the hands of the local people, and this ensures local and grassroots participation in the development process. For these reasons, there is a need for as much autonomy as possible for the development authorities.

This autonomy does not mean that the authorities would be completely independent of operational Ministries within the Government. Nor does it imply that the Government would not control the operations of the Authority in question. Rather; the argument here is for efficiency, unnecessary delays

in executions of decisions, and grassroots economic and social participation.

The details of the structure of an autonomous authority required has been outlined by Dr. Walter Oyugi's paper. While there may be differences of opinion as to certain aspects of the structure, the paper offers ideas upon which to base the discussion of the nature of the required authority.

From the foregoing, it is clear that development along a water basin is an idea whose time has come. What is needed is a set of corresponding concepts to transform the idea into reality.

III. THE COMPREHENSIVE AND INTEGRATED PLANNING APPROACH

This paper argues that the most effective approach to the development of the area is the comprehensive and integrated planning approach. For purposes of clarity in exposition, these terms need to be defined.

By development planning I mean a conscious effort made by any government to pursue a definite pattern of economic development in order to promote rapid and fundamental change in the economy and society. It is clear that planning, as thus defined, is a fairly broad concept which seeks to promote a fact rate of growth as well as influence significant structural socio-economic changes through government intervention.

A regional development plan is comprehensive if it sets its targets to cover all major aspects of the regional economy. It is partial if it covers only a part of the regional economy - industry, agriculture, the public sector and so forth.

An integrated regional development is a broad spectrum of development activities encompassing the simultaneous fostering of different aspects of progress, improvements of levels of living (incomes, employment, education, health and nutrition, housing and other social services) for the people in the region, reducing inequality in the distribution of regional incomes and economic opportunities, and the capacity of the region to sustain and accelerate the pace of these improvements over time.

I believe that a comprehensive and integrated planning is required for the development of the Lake basin.

Such planning has several advantages. First, it leads to the socially optimal allocation of resources in the long-run. This optimal allocation cannot be achieved by private investors who are mainly interested in the short-run profit maximization. Second, rapid economic transformation would be retarded if necessary institutional and structural reforms were not carried out simultaneously. Planning achieves the necessary institutional reforms to allow for more rapid transformation. Third, planning may exert some psychological impact upon the people in the region and this impact is conducive to the attainment of the higher standard of living. Finally, overall planning mechanism promotes the utilization of the scarce resources in the most productive way in all different sectors and subsectors of the region.

The next issue pertains to the role of government in the development plan. Government participation fundamentally effects the nature and character of the various development projects within the plan. Several types of planning do exist, and their analyses may help us in the examination of our subject. There is the totalitarian planning in which the state - owns all the means of production. Here, the degree of state intervention is the highest. At the other extreme, the state does not own all the means of production. Planning here takes place through inducement rather than through control, and it is called indicative planning. In between these two extremes are cases of mixed planning where both the public and the private sector operate side by side. For the Lake Basin Authority, the question of Government participation is fundamental in the sense that the region has been a neglected area for a very long time. The Government may well decide to commit its increased resources to rectify the past weaknesses. This calls for as much state intervention as is necessary for the development of the region.

Planning horizons can vary considerably. There is the short-term planning which would last up to one or two years, while medium-term planning would last for three to five. Perspective plans may last for twenty years or more. Emergency plans are drawn up for a short period to deal with specific problems arising from emergency situations.

The considerations of planning horizons raise the question: Will the regional development plan be viewed in terms of short-term, medium-term or perspective? It seems to me that we need all these plans: short-term, medium-term, perspective, and emergency. The region has problems which call for all these planning types. In the long-run, noweverm we need to have mainly medium and long-term planning.

Planning may also be viewed as a system of activities comprising of five interdependent phases. These phases indicate the sequence of decisions that must be undertaken in the planning process. We need to consider all of them in detail in the process. They are as follows:

1. End-planning is concerned with what is wanted: the design of a desired future. This requires specifying goals, objectives, and ideals, short-run, intermediate, and ultimate ends. This term calls for careful selection of specific goals and objectives to be attained. It also calls into attention the significance of the time factor in goal attainment. More specifically, what are the clearly stated goals and objectives of the development authority? When are the time-span of the achievement of these goals?

2. Means planning deals with the question of how to get there. This requires selecting or inventing courses of action, practises, programmes, and policies. It is important to design clearly the methods to be applied when making efforts to reach the goal. What methods and programmes will get us there most efficiently? These methods and programmes need to be clearly specified.

3. Resource planning examines what types of resources and how they are to be acquired or generated, and how they are to be allocated to activities once they are available. This question is to be dealt with later, but it is a fundamental one in the whole subject.

4. Organisational planning determines organisational requirements and designing organisational arrangements and the management system that will make it possible to follow the prescribed means effectively. The matter is not dealt with in this discussion. But I have argued earlier that we need an nomous authority which will have the powers to make and execute decisions without undue hindrance from bureaucratic procedures and practices. Furthermore, in order to effect efficiency in the operations, we need a decentralized decision-making units in a simplified organisational arrangements and management system.

5. Implementation and Control planning deal with the question of how to implement decisions and control them. In addition, they deal with the problem of how to maintain and improve the plan under changing internal and external conditions. This matter will be discussed later.

IV. BASIC INFORMATION REQUIRED FOR COMPREHENSIVE AND INTEGRATED PLANNING

The application of the planning concepts as outlined above to the development of the Lake Victoria Basin requires specific knowledge about the region. Such knowledge is absolutely essential to planning because it provides the planner with the necessary raw materials which form the basis of decisions. It is to be emphasized here that the most important parts of the basin is the water system in the region. However, since we are considering comprehensive and integrated planning, inclusion of other related areas is in order. The following is a set of specific knowledge needed.

1. Definition of the Lake Victoria Basin.

What area does the Lake Basin cover? This question is crucial. In the course of discussing the paper, several views were aired. These may be summarised as follows:

(a) The Political Definition of the Region. The proponents of this view argue that the Lake Basin Development Authority was Presidential gift to the people of Nyanza and therefore the Authority is ipso facts confined to administrative boundary of the Nyanza Province. They emphasize that President Moi, on the occassion of such visits to various areas in Kenya, has been giving the visited areas such things as schools, added classes and classrooms, roads, and the like. When he visited Kisumu, he did not offer any other "gift" to the people except the Development Authority. Hence the strong argument for confining the Authority to Nyanza.

(b) The Catchment Area Definition. The people holding this view argue that the Lake basin cannot be confined to the Nyanza Province because the areas affected by the basin covers the water catchment region which embraces the Nyanza, Western and Rift Valley Provinces. They point out that it is difficult to arbitrarily out off regions from where water originate - sources of the basin - in order to confine the definition to Nyanza. They argue that the definition should consider the region as bounded by Mt. Elgon, the Cherangani Hills, the Western Mau and the Loita Hills. This area covers 46,000 square kilometres or 8 per cent of the land area in Kenya.

(c) The Presidentially Decreed Definition. The question of definition of the Lake Basin was settled when President Moi told a visiting delegation from the Western Province at State House that the Lake Victoria Basin Development Authority is defined to cover the Nyanza and Western Provinces.

(d) Dr. Odidi Okidi's Definition of the Region. In his paper, "What Resources to Develop in the Lake Victoria Basin: A Workshop Proposal," (March 1979, p.1), Dr. Okidi presented a lengthy case for the definition of the region which he offered. The following in his definition:

> A lake basin may be defined as its catchment area whose drainage system contributes water towards a common terminus. In the present case the idea of development focuses on various uses to which its water can be put to enhance development. But the area to be developed is not confined to the lowlands or plains immediately surrounding the Lake. Rather, it applies to the entire area of the drainage. This is the idea which facilitates management of the water in its various quantities and quality from its very sources. It is the idea which underlies what the directive on the Authority said with respect to management of the waters of the rivers to prevent floods through storage and beneficial uses which may include irrigation during times of drought and harnessing water for hydroelectric power generation. In effect, the authority to be established might concentrate operation largely within Nyanza and Western Provinces, but with clear jurisdiction outwards as dictated by the patterns of such drainage systems like rivers Sio, Nzoia, Yala Nyando, Miriu, Awach, Kuja and Mara; among others, as may be hydrologically determined. This would mean some projects of the Authority being also in some Western parts of the Rift Valley Province

I am in agreement with this definition and believe that, in practical operations of the Authority's projects and programmes, it will be impossible to ignore the Rift Valley Province. Thus, while the core of the Authority is centred in the Nyanza and Western Provinces, the peripheral regions of Western Rift Valley will also be involved in the development programmes of the Authority.

2. Demographic considerations:

(a) How many people live in the region? If the region is defined comprehensively, then there is an estimated 6.2 million people who live in the Lake Victoria catchment area, this population comprises 40 per cent of the total Kenya population. On the other hand, if the definition is limited to a region immediately surrounding the Lake, then there are about 3 million people.

(b) What is their age, sex, ethnic, and racial compositions? Detailed analyses of these areas are required.

(c) What is the population density in the region? Some areas within the region are extremely heavily populated.

The Kisii, Maragoli and some places in South Nyanza are very highly populated. Some regions are sparsely populated.

Since planning is for the welfare of the people, considerations of the above questions enables the planner to plan more effectively for the different kinds of dwellers in the region.

3. Ecological Zone of the region:

During the decade of the 1960s, it appeared as if the climate and the weather in the region were changing. More rains seemed to be pouring over the region throughout the year. But the current weather and rainfall patterns are different. If this observation is correct, then one may wish to know:

(a) What kinds of weather and climate changes have occurred recently, and what do we expect in the future about these?

(b) What are the consequences of the changing weather pattern to the region?

4. Resources of the region:

(i) Water resources: This is fundamental to the development of the region. Since water is the key factor in this inquiry, it is necessary to acquire knowledge concerning the inflow and outflow of water into and out-of the Lake.

More specifically: - How much water empties into the Lake daily, monthly and yearly? I understand that the Ministries of Agriculture and Water Development have made such calculations. Such information should be made available to the planners for use. - Which are the biggest rivers draining into the Lake? A comprehensive definition of the area would consider the following rivers: Malawa, Nzoia, Yala, Nyando, Sondu, Migori, and Miriu. But this definition does not consider other important rivers in the region such as Kuja, Awach, and another Awach.

- How much water flows out of the Lake?

- What are the consequences of these to the level of the Lake?

- In the 1960s, it was clearly observed that the Lake water level was rising and hence over flooding the surrounding shore areas, thereby claiming more land areas. What brought about this? How much land has been "eaten" by the Lake water recently?

(ii) Water Resources: Fish. Lake Victoria is famed for its fresh-water fishes. Generations and generations of the Lake shore dwellers have lived on fish as their stap . Recently, however, there have been complaints by the people around the Lake that certain types of fish are disappearing; that the big fish ("Nyamani") have eaten all the small ones, especially tilapia ("Ngege"): and that fish is becoming increasingly scarce in the region. These issues call for considerations concerning:

(a) How many types of fish are there in the Lake and the surrounding rivers?

(b) In what quantities?

(c) What is the trend of the fish population?

(d) Where do these fishes come from - from Ugandan, Tanzanian, or Kenyan side of the Lake?

(iii) Water Resources: Other resources. Apart from fish, what other resources are there within the Lake? And in what quantities?

(iv) Resources surrounding the Lake shore. What kinds of natural resources, and in what quantities, surround the Lake shore?

The main concern here is with:

- the types of soils at the shore and their potential use; and
- the forestry and other natural vegetations:

(v) Resources in the Basin area:

Depending on the area covered by the definition of the Lake Basin, most of the major resources include:

Agricultural resources. These embrace the following products: rice, cotton, maize, millet, wheat, cassava, potatoes, sisal, sugar, tomatoes oranges, coffee, pyrethrum. The question here is: how much of each of these crops are produced in the region? What types of the products are comprised of each? What is the nature of distribution of each crop within the region?

It is important to note that in terms of national production, the following crops, grown in the catchment area during 1977, were estimated consitute the following percentages:

Maize	- 53%
Wheat	- 45%
Rice	- 10%
Sugar-cane	- 97%
Bananas	- 32%
Tea	- 32%
Coffee	- 25%

These data indicate the significance of the area to agricultural production of Kenya

- Animal resources: In these region, different kinds of animals are kept: cattle, sheep, goats, being the most common ones. The question is: How many of each of these animals are there in the region, and in what localities within the area? What types of animals are they? There are pieces of information on the animal 500,000 are grade and 3.1 million small stock. These data do not answer the questions raised above.

These issues have centred largely on the question of resource endowments of the Lake Basin area. They are important questions, and the picture of the economic potentialities of the region.

But resources have to be transformed into actual products to fulfil the human needs. Therefore, it is important also to consider other factors that facilitate the exploitation of these resources. Without them, the natural endowments would remain idle . Hence, it is necessary to explore the degree and extent of the existence of these other factors.

5. Infrastructure:

The existence of the communications network determines to a large extent the degree by which the resources can be explored. Roads, railways, waterways, airways, telephones are absolutely necessary for the efficient production and distribution of the region within and outside the region. Hence, it is necessary to know:

(a) What roads, railways, waterways, telephones, airways, and other means of communications exist in the area?

(b) In which quality and quantity?

(c) How are these distributed in the area?

6. Financial and Credit Institutions.

The actual exploitation of the resources depends a great deal on the availability of the funds which could be used to buy factor inputs such as machines and equipments, labour inputs, and land including office space. Therefore, it is necessary to know:

(a) How many banks there are in the region?

(b) What kinds of banks are they?

(c) What other credit and financial institutions exist in the area?

7. Patterns of Trade:

Trade does play a major role in the overall development of the resources. Where there are lucrative markets for products, there will be vigorous and energetic efforts to increase the production of the traded goods. Where markets do not exist, there will be a concommitant relaxation of production. Therefore, we need to know something about the nature of markets in the area.

(a) What does the region produce and consume internally?
What is the nature of the internal markets?

(b) What does the region export to other regions and to foreign countries? And in what quantities?

(c) What does the region import from the rest of Kenya and from abroad? And in what quantities?

8. Institutions for Human Resource Development:

Human skills play a most important role in resource exploitation. These skills are usually acquired formally through education and training. Formal education does provide people with the capacity to absorb knowledge; but informal education equips people with specialized skills. Both are needed for resource exploitation. Therefore, the development of the area is limited only by the extent of the available human skills. Consequently, it is important to know:

(a) How many primary, secondary, and Teacher Training Colleges are there in the area?

(b) How many students attend these institutions:
- Colleges of Science and Technology?
- specialized institutions?

9. Health and Medical Facilities:

A healthy population is necessary for development. People who are healthy are not only more productive than the sickly ones, but they are also more creative and energetic. It is important therefore to know what health and medical facilities exist in the area:

(a) What are the major diseases in the region?

(b) How many hospitals and other health facilities are there in the region?

(c) How many doctors, nurses, and hospital assistants are there? What is their professional composition?

(d) How are these medical personnel distributed within the area?

10. Industrial Establishment and Distribution:

It is important to know what industries do exist in the region. This knowledge forms the basis of decision of what industries to strengthen or add. Therefore, the following questions are necessary to address ourselves to:

(a) What kinds of industries are there in the region?

(b) Who owns these industries?

(c) What proportions of raw materials based industries are there

11. Employment in the Region.

Any development effort must concern itself as much as possible with the development of the people. After all, development itself is meaningless unless it is aimed at improving the living standards of the people. Employment generation is the most important consideration in any development effort. As a starting point, it is necessary to know:

(a) What the major industries employing most people in the area?

(b) What is the proportion of wage/no-wage employment in the area?

(c) What is the rate and level of unemployment in the region?

(d) What are the patterns of migration within the region and outside it?

- rural-rural
- rural-urban
- urban-rural
- urban-urban.

12. Facilities for Tourist Attraction:

Tourism is needed because it increases the demand for the local resources and products. It therefore brings external money into the area. But tourists have to be attracted through several means. Hence the need to know what facilities exist for tourists:

(a) What tourist attraction sites have been developed in the area?

(b) What hotel and other accommodation arrangements are there for the tourists?

(c) What is the level and nature of tourists to the region?

V. FRAME-WORK OF DECISION

Knowledge of the existance of resources alone does not constitute the development of those resources per se. What is reccuired is the transformation of those resources into tangible goods and services which satisfy the needs. But it is not possible to tackle all the development problems at once and simultaneously. We do not have enough rescurces to do comprehensively only with the most important issues. The following is a list of important considerations.

(i) Development of Resources:

(1) What resources in the region are to be developed?

(2) Which ones are to be given priority?

(3) How are these resources to be developed?

(4) What is the time frame for this development?

(ii) Development of Human Resources:

(1) What institutions should be developed for the purpose of developing the resources?

(2) What specific skills should be developed for utilization in which industries?

(3) How are these skills to be developed: Through practical or academic (or both) training?

(4) What is the time frame within which to develop them?

(iii) Development of Fisheries.

(1) What types of fish to develop;

(2) How are these to be developed?

(3) What resources are required for this?

(4) What markets are to be developed internally and externally for the fish products?

(iv) Development of the Infrastracture:

(a) Which roads are to be improved or built: and where?

(b) When are the railways extentions to be made:

(c) What new waterways are to be established?

(d) Is the Kenya irways going to extend its regular services to the Western area of Kenya? When?

(e) Other forms to infrastructure: telephones and the posts and telecommunications.

(b) What machinery is to be developed to ensure that the development of the basin remain as much apolitical as possible?

VII. LIMITATIONS OF THE PLANNING APPROACH TO REGIONAL WATER BASIN DEVELOPMENT

Although planning approach is considered the best approach, it has several weaknesses. These weaknesses may cause problems to the development itself. The following are problems areas which need careful though:

(1) The Multidisciplinary Approach to Development Planning:

The development planning, as we have outlined above, is a purely economic exercise. It does not consider other equally important disciplines. For example, the changes in social attitudes and relationships which may themselves be considered detrimental to the healthy existence of the very society. What do economists know about social change? What about cultural changes emanating from regional development? Clearly, the need for a planning team comprised of economists, engineers, sociologists, health officers, lawyers political scientists is a necessity. Economists alone cannot do it effectively.

( ) Political Consequences:

The comprehensive and integrated regional development plan incurs the shifting of scarse resources from one use to another, and from one sub-region to another. What are the likely consequences of these resource use and shifts? Again, there are problems of political jealousies among the politicians, these may emanate from the successes of the development projects.

What do we know about the consequences of political battles to the healthy existence of the development efforts?

(v) Development of agriculture:

(a) What agricultural crops are to be developed first: cash-crops or food-crops?

(b) How are these crops to be developed?

(c) What internal and external markets are to be cultivated for agricultural products?

(vi) Development of Mineral Resources:

(a) Which mineral resources are to be developed?

(b) How are these to be developed?

- through private individuals
- through government mechinery?

(vii) Financial and Credit Facilities:

What programmes are there to strengthen the existing financial and credit facilities or to create new ones in order to promote the regional development programmes?

VI. PLAN IMPLEMENTATION

1. Monitoring the fulfilment of the plan objectives:

(a) Who takes the responsibility to see that the plan is implemented?

(b) Who retains the final responsibility for the overall development of the region?

2. Creation of a permanent body which will see to it that plan objectives are attained regardless of political changes or differences in political views in the country and the region.

(a) How can that be done?

3. Adverse Environmental Effects:

It is quite possible for regional development effort to have an adverse effects on the region. For example, the Jonglei Canal in Sudan is being opposed by environmentalists because they believe that the project will have an adverse environmental effects in the region. (see The Weekly Review, April 28, 1978, p. 24). What ecological and other environmental

consequences will the region have as a result of comprehensive and integrated development plan?

4. External Adverse Consequences Emanating From the Development Plan Itself:

The success of the development project itself may cause various problems that were never foreseen at the time of drawing the plan. Or they may have been seen, but were ignored as being inconsequential. These external factors, considered before or not, may be detrimental to the society itself and may outweigh the benefits gained through the successes of the plan. Several examples of such cases abound. For example, the Kenya fisheries authorities introduced "Nyamamis" (the "Nile perch") into the Lake Victoria in 1960's. They were introduced because they are said to lucrative. And indeed they did multiply. As a result of this action, the small fishes have disappeared from the Lake. Rumours have it that these "Nyamamis" have eaten the small fishes out of existence. Rumours also have it that the Fisheries Department is now introducing some more crocodiles into the Lake to eat the "Nyamamis" so as to enable the small fishes to increase in the Lake.

The material contained as examples in the foregoing paragraph has been strongly reputed by officers from the Department of Fisheries of the Ministry of Natural Resources. They deny the allegation that the "Nyamamis" have eaten the small fishes, especially "Ngege"; they also deny that plans are underway to introduce crocodiles into the Lake to eat the "Nyamamis". Apparently, the question of disappearance of small fishes from the Lake has also been a matter of concern to the Department, for the officers involved have presented detailed papers aimed at offering explanations as to the possible causes of the demise of the smaller species of the fishes.

Another example is the success of the Aswan Dam. This dam has indeed succeeded in helping Egypt irrigate its dry lands. But it has also caused serious problems for Egypt. First, it has reduced drastically the number of fish to be consumed in Egypt. This is because the Dam withholds all the necessary food for fish. Secondly, all the soil that was needed for brick-making has also been withheld in the Dam. As a result, there is a serious shortage of bricks in Egypt. Thirdly, the Lake Nasser made by the Dam has been overflooding its banks, thereby covering the railroads passing by the Dam. This has implied re-building of the railroad. Finally, the waters of the River Nile and of the Mediterranean Sea have been eating into the land increasingly because the silts which used to prevent this have been

retained by the Aswan Dam. These are serious adverse consequences for the society.

What adverse effects are there likely to be are a result of the success of the Lake Basin Development?

5. The Need for Cooperation from the Surrounding Countries:

It is important to involve other surrounding countries in the regional development of the Lake Basin. Tanzania and Uganda should be involved in some way. For example, Tanzania is now considering building an irrigation scheme in Central Tanzania, What likely effects is this scheme going to have on the development of the Lake Basin? Furthermore, the Mara River empties into the Lake on the Tanzanian side, while one of the major rivers in the Lake Basin empties into Lake Kyoga in Uganda and thence into the White Nile. This means that decisions made on the use of these rivers will affect all the three countries. Moreover, the Lake fishes migrate from one region to another, without considering territorial limits. For these reasons, it appears as if it is necessary to have some cooperative agreements with these surrounding territories.

6. Lack of Experience in Development Effort Through Water Basin and Resources.

This point was emphasized by Mr. James Otieno, a Senior Planning Officer in the Ministry of Planning and Community Affairs, during his discussion of this paper. He argued that Kenya has not had experience in the area of development planning of a water basin region. We are therefore venturing into unknown quantities and may consequently make mistakes. But he agreed that, despite this lack of practical experience, the time has now come for Kenya to learn from its mistakes in this area. I believe we should learn from doing. The Lake basin development will surely require a lot of learning, imaginations and efforts.

VIII. CONCLUSION

The idea of development through a water basin is the idea whose time has come, but requires new approaches in its application to tangible economic realities. The best approach is the regional comprehensive and integrated development planning which has short-term, medium-term, perspective, and emergency horizons. Such kinds of planning require detailed information about the area and its resources. Without such knowledge, meaningful planning cannot exist.

Since it is impossible to implement all the various objectives at the same time, it is necessary to select some major areas for consideration. Such selections must be systematic and thorough. Plan implementation must be considered in detail. This is to ensure that the plan objectives are attained. Development plan failures and other external adverse effects must be considered during the planning process.

In the whole exercise, the emphasis is placed in the need for autonomy of the Development Authority. Such an autonomy will lead to efficiency, greater mass participation, and immediate plan implementation. All these factors are necessary for the success of the plan.

The other important consideration is the degree of Government involvement in the whole development process in the region. It is my considered opinion that the Government should be fully involved in the scheme in order to remedy the poverty situation in much of the region. The region has been a much neglected area, and only massive Governmental aid can rectify the situation.

APPENDIX I

TANA RIVER DEVELOPMENT AUTHORITY:

This Authority was set up by the Tana River Development Authority Act 1974, No.7. The initial team composition was:-

Executive Chairman
Team Leader
Water Resource Engineer
Hydrologist
Agriculturalist
Agricultural Economist
Ecologist (Sociologist)

The terms of reference for the TRDA are:-

(a) to advise the Government generally and the Ministries of Economic Planning, Agriculture, Natural Resources and Power in particular on all matters affecting the development of the area including the apportionment of water resources;

(b) to draw up, and keep up-to-date, a long-range development plan for the Area;

(c) to initiate such studies, and to carry out such surveys of the Area as it may consider necessary, and to assess alternative demands within the Area on the resources thereof, including electric power generation, irrigation, wildlife, land and other resources, and to recommend economic priorities;

(d) to co-ordinate the various studies of, and schemes within, the Area so that human, water, animal, land and other resources are utilized to the best advantage, and to monitor the design and execution of planned projects within the area;

(e) to effect a programme of monitoring of the performance of projects within the Area so as to improve such performances and establish responsibility thereof, and to improve future planning;

(f) to ensure close co-operation between all agencies concerned with the abstration and use of water within the Area in the setting up of effective monitoring of such abstraction and use;

(g) to collect, assemble and correlate all such data related to the use of water and other resources within the Area as may be necessary for the efficient forward planning of the Area;

(h) to maintain aliaison between the Government, the private sector and foreign agencies in the matter of the development of the Area with a view to limiting the duplication of effort and to assuring the best use of technical resources;

(i) render assistance to operating agencies in their application for loan funds if required.

APPENDIX II

(Kenya Gazettee Supplement No. 59 (Acts No. 9) 31/8/79)

THE KERIO VALLEY DEVELOPMENT AUTHORITY - ACT 1979

An Act of Parliament to provide for the establishment of an authority to plan and co-ordinate the implementation of development projects in the Kerio and Turkwell catchment areas and for matters connected therewith and incidental thereto.

ENACTED by the Parliament of Kenya, as follows:-

1. This Act may be cited as the Kerio Valley Development Authority Act, 1979.

2. In this Act, unless the context otherwise requires - "Area" means the area drained by, and bounded by the watersheds of, the Kerio and Turkwell Rivers and their tributaries;

"Authority" means the Kerio Valley Development Authority established by section 3;

"chairman" means the person appointed as chairman of the Authority under paragraph (a) of subsection (1) of section 4;

"the Minister" means the Minister for the time being responsible for matters relating to economic planning;

"non-official members" means the chairman and the members of the Authority appointed under paragraph (h) of subsection (1) of section 4.

3. There is hereby established an Authority which shall be a body corporate by the name of the Kerio Valley Development Authority, with perpetual succession and a common seat, and which shall be capable in the corporate name of-

(a) suing and being sued;
(b) taking, purchasing or otherwise acquiring, holding, charging and disposing of property, movable or immovable;
(c) borrowing and lending money;
(d) entering into contracts;
(e) doing or performing all such other things or acts necessary for the proper performance of its functions under this Act which may lawfully be done or performed by a body corporate.

4. (1) The Authority shall consist of the following members-

(a) a chairman who shall be appointed by the President;
(b) the Permanent Secretary of the Ministry for the time being responsible for economic planning;
(c) the Permanent Secretary of the Ministry for the time being responsible for finance;
(d) the Permanent Secretary of the Ministry for the time being responsible for agriculture;
(e) the Permanent Secretary of the Ministry for the time being responsible for Health;
(f) the Provincial Commissioner, Rift Valley Province;
(g) the chairman of the East African Power and Lighting Company Ltd.;
(h) eight other members appointed by the Minister in consultation with the President, four of whom shall be from the area covered by the operations of the Authority;
(i) the Managing Director appointed under section 9.

(2) Subject to this section-
(a) the chairman shall hold office for a period of three years from the date of appointment;
(b) the members appointed under paragraph (h) of sub-section (1) shall hold office for a period of three years from the date of appointment.

(3) A retiring member shall be eligible for reappointment.

(4) If the Minister is satisfied that any of the non-official members-

(a) has been guilty of improper conduct; or

(b) is incapacitated by prolonged physical or mental illness; or

(c) is unable or unfit, for any other reason, to discharge the duties of his office,

and that it would be in the interest of the Authority so to do, he may terminate the appointment of such member.

(5) The office of a non-official member shall become vacant-

(a) upon the expiry of his term of appointment; or

(b) upon the termination of his appointment under sub-section (4); or

(c) upon the expiry of one month, or such shorter period as may be mutually agreed, after the date upon which the Minister receives a written notice signed by the member of his intention to resign; or

(d) if he is absent without the permission of the Authority from three consecutive meetings of the Authority of which he has had reasonable notice.

(6) The non-official members shall be paid by the Authority such remuneration and allowances as the Minister may from time to time determine.

5. (1) The Authority shall be convened by the chairman at least three times in every year.

(2) The Authority shall elect a vice-chairman from among its members.

(3) The chairman, or in his absence the vice-chairman, may at any time convene a special meeting of the Authority, and shall do so within fourteen days of receipt by him of a written requisition signed by at least three members.

(4) The quorum necessary for the transaction of any business of the Authority shall be ten members; and all acts, matters or things authorized or required to be done by the Authority shall be effected by a resolution passed by a majority of the members present and voting at a meeting at which a quorum is present.

(5) The chairman, or in his absence the vice-chairman, shall preside at all meetings of the Authority; except that in case of the absence of both the chairman and the vice-chairman the members present shall elect one of their number to preside at that particular meeting.

(6) At every meeting of the Authority the member presiding shall have a casting as well as a deliberative vote.

(7) Subject to subsection (4), no act, decision or proceedings of the Authority shall be questioned on account of any vacancy in the membership thereof or on account of any defect afterwards discovered in the appointment of any of its members.

(8) Subject to this Act, and to any general or specific directions of the Minister, the Authority shall regulate its own procedure.

6. (1) The common seal of the Authority shall be authenticated by the signature of the chairman and such other members of the Authority as may be generally or specially authorized by the Authority.

(2) All documents, other than those required by law to be under seal, made by, and all decisions of, the Authority may be signified under the hand of the chairman, or, in the case of a decision taken at a meeting at which the chairman was not present, under the hand of the person presiding at such meeting.

7. The Authority may from time to time appoint such committees, whether of its own members or otherwise, as it may think necessary but no decision of any committee shall be effective unless it has been confirmed by the Authority.

8. (1) The Authority may appoint, upon such terms and conditions as it thinks proper, such other officers and servants as it considers necessary or desirable for the efficient conduct and operation of the Authority.

(2) Every member of staff shall, subject to this Act, exercise such powers and functions and perform the duties assigned to him from time to time by the Managing Director.

(3) The members of staff appointed under subsection (1) all be paid out of the funds of the Authority such salaries as the Managing Director, with the approval of the Authority, may from time to time determine and such travelling and other expenses as they may incur in the performance of their duties.

9. (1) There shall be an officer of the Authority, to be known as the Managing Director, who shall be appointed by the Minister and who shall be responsible for the execution of the policy of the Authority and for the control and management of its day-to-day business.

(2) The Authority shall delegate to the Managing Director such of its functions under this Act as are necessary for the effective transaction of the day-to-day business of the Authority, and in particular the Authority shall delegate to the Managing Director the power, subject to any instructions of a general nature as may be given by the Authority-

(a) to control and supervise the acts of all officers and servants of the Authority in the matters of executive administration and in all matters concerning the accounts and records of the Authority; and

(b) to dispose of all questions relating to the service of the officers and servants of the Authority and their pay and privilege.

10. The functions of the Authority shall be-

(a) to plan for the development of the Area and initiate project activities identified for such planning through the Government generally.

(b) to develop and keep up-to-date a long range development plan for the Area;

(c) to initiate such studies, and to carry out such surveys, of the Area as may be considered necessary by the Government or by the Authority and to assess alternative demands within the Area on the resources thereof, including agriculture (both irrigated and rainfed), forestry, wildlife and tourism industries, electric power generation, mining, and fishing and to recommend economic priorities;

(d) to co-ordinate the various studies of, and schemes within, the Area so that human, water, animal, land and other resources are utilized to the best advantage and to monitor the design and execution of planned projects within the Area;

(e) to effect a programme of both monitoring and evaluating the performance of projects within the Area so as to improve such performance and establish responsibility thereof and to improve future planning;

(f) to co-ordinate the present abstraction and use, and the planned abstraction and use, of the natural resources especially water and set up an effective monitoring of such abstraction and usage;

(g) to cause the construction of any works necessary for the protection and utilization of the water and soils of the Area;

(h) to ensure that the landowners in the Area undertake all the measures specified by the Authority to protect the water and soils of the Area;

(i) to identify, assembly and correlate all the data related to the use of water and other resources within the Area as may be necessary for the efficient forward planning of the Area;

(j) to maintain a liaison between the Government, the private sector and other agencies in the matter of the development of the Area with a view to limiting the duplication of effort and ensuring the best use of technical resources.

11. The funds of the Authority shall consist of-

(a) such moneys as may from time to time be provided by Parliament;

(b) moneys borrowed by the Authority on such terms and for such purposes as the Minister, in consultation with the Minister for the time being responsible for finance, may approve;

(c) any moneys accruing to the Authority from any other source.

12. (1) The Authority shall cause to be kept all proper books and records of account of the income, expenditure, assets and liabilities of the Authority and shall prepare such other accounts as the Minister may require and, in addition, shall prepare a yearly balance sheet made up to the end of each financial year.

(2) At the end of each financial year, the accounts of Authority shall be audited by the Controller and Auditor-General.

(3) At the completion of an audit under this section the Controller and Auditor-General shall make a report thereon to the Authority and shall at the same time furnish a copy of the report to the Minister.

13. (1) The Authority shall, within a period of six months after the end of each financial year or within such longer period as the Minister may approve, submit to the Minister a report of its operations and activities during that year, together with the yearly balance sheet and such other statements of account as the Minister shall require; and the Authority shall publish them in such manner as the Minister may specify.

(2) The Minister shall lay both the Authority's and the Controller and Auditor-General's report, together with the yearly balance sheet and such other statements of accounts as the Minister may deem appropriate, before the National Assembly as soon as reasonably practicable.

14. No act or thing done by any member of the Authority or by any officer or servant of the Authority, shall, if the act or thing was done bona fide for the purposes of carrying this Act into effect, subject him personally to any liability, action, claim or demand whatsoever.

15. No duty shall be chargeable under the Stamp Duty Act in respect of any instrument executed by or on behalf of or in favour of the Authority in cases where, but for this section, the Authority would be liable to pay such duty.

APPENDIX III

(Kenya Gazettee Supplement No. 59(Acts No. 9) 31/8/79)

THE LAKE BASIN DEVELOPMENT AUTHORITY - ACT 1979

An Act of Parliament to provide for the establishment of an Authority to plan and co-ordinate the implementation of development projects in the Lake Victoria catchment area and for matters connected therewith and incidental thereto.

ENACTED by the Parliament of Kenya, as follows:-

1. This Act may be cited as the Lake Basin Development Authority Act, 1979.

2. In this Act, unless the context otherwise requires - "Area" means the Lake Victoria catchment area;

"Authority" means the Lake Basin Development Authority established by section 3;

"chairman" means the person appointed as chairman of the Authority under paragraph (a) of subsection (1) of section 4;

"development area" means that part of the Lake Victoria catchment area situate within the Western and Nyanza Provinces;

"the Minister" means the Minister for the time being responsible for matters relating to economic planning;

"non-official members" means the chairman and the members of the Authority appointed under paragraph (h) of subsection (1) of section 4;

3. There is hereby established an Authority which shall be a body corporate by the name of the Lake Basin Development Authority, with perpetual succession and a common seal, and which shall be capable in its corporate name of-

(a) suing and being sued;
(b) taking, purchasing or otherwise acquiring, holding, charging and disposing of property, movable or immovable;
(c) borrowing and lending money;
(d) entering into contracts;
(e) doing or performing all such other things or acts necessary for the proper performance of its functions under this Act which may lawfully be done or performed by a body corporate.

4. (1) The Authority shall consist of the following members-

(a) a chairman appounted by the President;

(b) the Permanent Secretary to the Ministry for the time being responsible for economic planning;

(c) the Permanent Secretary to the Ministry for the time being responsible for finance;

(d) the Permanent Secretary to the Ministry for the time being responsible for agriculture;

(e) the Permanent Secretary to the Ministry for the time being responsible for health;

(f) the Provincial Commissioner, Nyanza Province;

(g) the Provincial Commissioner, Western Province;

(h) eight other members appointed by the Minister in consultation with the President, four of whom shall be appointed from the area affected by the operations of the Authority;

(i) the Managing Director appointed under section 10.

(2) Subject to this section-

(a) the chairman shall hold office for a period of three years from the date of his appointment; and

(b) the members appointed under paragraph (h) of sub-section (1) shall hold office for a period of three years from the date of their appointment.

(3) A retiring member shall be eligible for reappointment.

(4) If the Minister is satisfied that any of the non-official members-

(a) has been guilty of improper conduct; or

(b) is incapacitated by prolonged physical or mental illness; or

(c) is unable or unfit, for any other reason, to discharge the duties of his office,

and that it would be in the interest of the Authority so to do, he may terminate the appointment of such member.

(5) The office of a non-official member shall become vacant-

(a) upon the expiry of his term of appointment; or

(b) upon the termination of his appointment under sub-section (4); or

(c) upon the expiry of one month, or such shorter period as may be mutually agreed, after the date upon which the Minister receives a written notice signed by the member of his intention to resign; or

(d) if he is absent, without the permission of the Authority, from three consecutive meetings of the Authority of which he had reasonable notice.

(6) The non-official members shall be paid by the Authority such remuneration and allowances as the Minister may from time to time determine.

5. (1) The Authority shall be convened by the chairman at least three times in every year.

(2) The Authority shall elect a vice-chairman from among its members.

(3) The chairman, or in his absence the vice-chairman, may at any time convene a special meeting of the Authority, and shall do so within fourteen days of receipt by him of a written requisition signed by at least three members.

(4) The quorum necessary for the transaction of any business of the Authority shall be ten members inclusive of the person presiding; and all acts, matters or things authorized or required to be done by the Authority shall be effected by a resolution passed by a majority of the members present and voting at a meeting at which a quorum is present.

(5) The chairman, or in his absence the vice-chairman, shall preside at all meetings of the Authority; except that in the case of the absence of both the chairman and the vice-chairman the members present shall elect one of their number to preside at that particular meeting.

(6) At every meeting of the Authority the member presiding shall have a casting as well as a deliberative vote;

(7) Subject to subsection (4), no act, decision or proceedings of the Authority shall be questioned on account of any vacancy in the membership thereof or on account of a defect in the appointment of any of its members.

(8) Subject to this Act, and to any general or specific directions of the Minister, the Authority shall regulate its own procedure.

6. (1) The common seal of the Authority shall be authenticated by the signature of the chairman and such other person as may be generally or specially authorized by the Authority.

(2) All documents, other than those required by law to be under seal, made by, and all decisions of, the Authority may be signified under the hand of the chairman, or, in the case of a decision taken at a meeting at which the chairman was not presented, under the hand of the person presiding at such meeting.

7. The Authority may from to time appoint such committees, whether of its own members or otherwise, as it may think necessary but no decision of any committee shall be effective unless it has been confirmed by the Authority.

8. The functions of the Authority shall be-

(a) to plan for the development of the Area and initiate project activities identified from such planning in the development area through the Government generally;

(b) to develop an up-to-date long range development plan for the Area;

(c) to initiate such studies, and carry out such surveys, of the Area as may be considered necessary by the Government or the Authority, and to assess alternative demands within the Area on the natural resources thereof, including agriculture (both irrigated and rainfed), forestry, wildlife and tourism industries, electric power generation, mining, and fishing, and to recommend economic priorities;

(d) to co-ordinate the various studies of schemes within the Area such that human, water, animal, land and other resources are utilized to the best advantage and to monitor the design and execution of planned projects within the Area;

(e) to effect a programme of both monitoring and evaluating the performance of projects within the development area so as to improve such performance and establish responsibility thereof, and to improve future planning;

(f) to co-ordinate the present abstraction and use of natural resources, especially water, within the Area and to set up an effective monitoring of such abstraction and usage;

(g) to cause and effect the construction of any works deemed necessary for the protection and utilization of the water and soils of the Area;

(h) to ensure that landowners in the Area undertaken all the measures specified by the Authority to protect the water and soils of the area;

(i) to identify, collect, collate and correlate all such data related to the use of water and other resources and also economic and related activities within the Area as may be necessary for the efficient forward planning of the Area;

(j) to maintain a liaison between the Government, the private sector and other interested agencies in the matter of the development of the development area with a to limiting the duplication of effort and to ensuring the best use of the available technical resources;

(k) to examine the hydrological effects and the subsequent ecological changes on the development programmes and evaluate how they effect the economic activities of the persons dependent on river and lake water environment;

(l) to consider all aspects of the development of the Area and its effects in the lake inflow and outflow;

(m) to monitor the operations and provide technical reports on the operations of any agreement or other arrangements between Kenya and other states relating to the use of the waters of Lake Victoria or of the River Nile.

9. (1) The Authority may appoint, upon such terms and conditions as it thinks proper, such other officers and servants as it considers necessary or desirable for the efficient conduct and operation of the Authority.

(2) Every member of staff shall, subject to this Act, exercise such powers and functions and perform the duties assigned to him from time to time by the Managing Director.

(3) The members of staff appointed under subsection (1) shall be paid out of the funds of the Authority such salaries as the Managing Director, with the approval of the Authority, may from time to time determine travelling and other expenses as they may incur in the performance of their duties.

10. (1) There shall be an officer of the Authority to be known as the Managing Director who shall be appointed by the Minister and who shall be responsible for the execution of policy of the Authority and for the control and management of its day-to-day business.

(2) The Authority shall delegate to the Managing Director such of its functions under this Act as are necessary for the day-to-day business of the Authority and in particular the Authority shall delegate to the Managing Director the power, subject to any istructions of a general nature as may be given by the Authority-

(a) to control and supervise the acts of all officers and servants of the Authority in the matters of executive administration and in all matters concerning the accounts and records of the Authority; and

(b) to dispose of all questions relating to the service of the officers and servants of the Authority and their pay and privileges.

11. The funds of the Authority shall consist of-

(a) such moneys as may from time to time be provided by Parliament;

(b) moneys borrowed by the Authority on such terms and for such purposes as the Minister, in consultation with the Minister for the time being responsible for finance, may approve;

(c) any moneys accruing to the Authority from any other source.

12. (1) The Authority shall cause to be kept all proper books and records of account of the income, expenditure, assets and liabilities of the Authority; and shall prepare such other accounts as the Minister may r - quire and, in addition, shall prepare yearly balance sheets made up to the end of each financial year.

(2) At the end of each financial year, the accounts of the Authority shall be audited by the controller and Auditor-General.

(3) The Authority shall produce and lay before the Controller and Auditor-General all the books and accounts of the Authority with all vouchers in support thereof, and all books, papers and writin in its possession or control relating thereto, and the Controller and Auditor-General shall be entitled to require from all members, officers and servants of the Authority such information and explanations as may be necessary for the proper performance of his duties.

(4) At the completion of an audit under this section, the Controller and Auditor-General shall make a report there on to the Authority and shall at the same time send a copy of the report to the Minister.

13. (1) The Authority shall within a period of six months after the end of each financial year or within such longer period as the Minister may approve submit to the Minister a report of its operations and activities during that year, together with the yearly balance sheet and such other statements of accounts as the Minister shall require, and the Authority shall publish the annual report and the yearly balance sheet in such manner as the Minister may specify.

(2) The Minister shall lay both the Authority's report and Controller and Auditor-General's report, together with the yearly balance sheet and such other statements of account as the Minister may deem appropriate, before the National Assembly as soon as reasonably practicable.

14. No act or thing done by any member of the Authority or by any officer or servant of the Authority shall, if the Act or thing was done bona fide for the purposes of carrying this Act into effect, subject him personally to any liability, action, claim or demand whatsoever.

15. No duty shall be chargeable under the Stamp Duty Act in respect of any instrument executed by or on behalf of or in favour of the Authority in cases where, but for this section, the Authority would be liable to pay such duty.

THE INSTITUTIONAL FRAMEWORK FOR THE LAKE VICTORIA BASIN DEVELOPMENT AUTHORITY

By

W. Ouma Oyugi
Senior Lecturer
Dept. of Government
University of Nairobi.

The intention to establish the Lake Basin Development Authority to spearhead development activities in the Lake basin was announced by his Excellency the President - Mr. Daniel T. Arap Moi at a public rally in Kisumu on 16th Dec. 1978. The decision was manifestly political as no government document had hitherto even remotely referred to that possibility. Kisumu or shall I say Nyanza, was last visted by a president in September 1969. That vist ended on a sour note. This time the new President was determined that a presidential visit should be seen in a new perspective. The announced intention to establish the Lake Basin Development Authority was thus a deliberate attempt to achieve that desire.

There were a number of assumptions implicity in the decision. First, the decision seemed to question the effectiveness of the existing structures in bringing about development in the area. Second, it also tended to imply a new realization on the part of the Government that the area around the lake has certain common characteristics which could be tackled developmentally only if the area were to be treated as a special entity - a region of some sorts. A regional approach to development was thus being called for. To demonstrate her seriousness of purpose, the government drafted a relevant Bill - The Lake Basin Development Authority Bill, 1979 - which on being passed by Parliament will give the proposed Authority a legal personality.[1]

The purpose of this paper therefore is to assess the potentiality of the Authority as an institution for development purposes. In doing that special attention will be paid to a number of related issues. They include:

i) Functional jurisdiction of the Authority.

ii) The analysis of the existing development structures as they relate to the issue of development.

iii) The proposed structures of the new Authority.

---

1. Kenya Gassette Supplement No. 32 Bill No. 8, 25th May 1979.

iv) The relationship between the New Authority and the existing structures.

In analysing these issues, their likely pattern of interaction and the implications thereof for national and areal development will be assessed.

AREA AND FUNCTIONAL JURISDICTION

The Bill defines the development area as "that part of Lake Victoria catchment area situated within the Western and Nyanza Provinces" This would tend to limit the operations of the Authority only to those areas in the two provinces that lie along the river valleys and around the lake itself. If that is the case, it would be necessary at some future time but before the Authority begins its activities in the areas, that what actually constitutes the area around the lake is defined. That is to say, how far into the mainland should the area extend?

It is important to establish the limit in view of the fact that already many people believe the Authority's activities cover practically the present Nyanza and Wester provinces. There are even those who in spite of the limiting provision of the Bill (to Nyanza and Western Provinces) still insist on giving the area an ideal geographical definition. In this regard, Professor Ogendo has suggested in his paper that for development purposes the area should be seen to consist of four contiguous zones as follows:

a) The core planning area of Nyanza
b) The core fringe zone of Western Province
c) The inner fringe zone forming the Western- most parts of the Rift Valley Province but within the Lake Basin catchment area
d) The outer fringe zone outside the Lake Basin Catchment area but forming parts of some of the districts partly within the Lake basin proper.

According to this classification, an additional eight districts in the Rift Valley would be included in the "development area." The paper by Professor S. Ominde also subscribes to this geographical definition of the "development area".

These definitions, it appears, tend to operate from the point of view of "the ". It should be pointed out, however, that political decisions are rarely governed by the criterion of "ideal". The decision to establish the Lake Victoria Basin Development Authority having been a political decision should be seen in that context - at least in the

formative stages of the Authority. This means that the area of coverage should be restricted. The need to remove any vagueness in the relevant clause of the Bill is important for obvious political reasons. Sooner or later voices will be heard, especially of the politicians, complaining about the exclusion of their areas from the activities of the Authority.

But even for the coverage stipulated in the Bill, if the activities of the Authority were to cover the entire Nyanza and Western provinces, the effectiveness of the Authority as a development agency of the government would be seriously impaired. Experience elsewhere tends to show that a development authority is effective only if it has a limited areas of operation. A major concern of the Government in establishing the Authority appears to be the control and utilization of water resources in the area. The Authority's boundaries should be limited accordingly. The danger is that if the Authority exists with boundaries considerably larger than the problem to be extraneous populations may share the cost of action from which they do not benefit and may demand costly side payments for cooperation in any joint effort.[2]

To suggest that the area of the programme should be limited is not to imply that the outlying areas in the two provinces should not share in the benefits that acrue from the activities of the Authority. The development of the resources of a region is a matter of concern to the whole country. Accordingly, it is incumbent upon the government to ensure that the Authority's activities are harmonized and coordinated with those of its surrounding environment. But in doing that care must be taken to ensure that the Authority's area of jurisdiction is clearly defined. The only caution here is that such an area should not be so large that it is not, in a management sense, workable. Reducing the area of operation simulteneously reduces the area of conflict in the activities of the organization.

Having examined the geographical coverage of the Bill, we now turn to the proposed activities of the Authority. The proposed functions of the Authority are outlined under Clause No. 8 of the Bill. They are rather limiting. To begin with, the Authority is charged with the planning for the development of the Area and initiate project activities identified from such planning in the development area through the Government generally and the scheduled Ministries (Agriculture, Economic Planning, Fisheries, Health, Industries, Natural Resources, Power Tourism, Water Development) or their

---

2. See for instance S.E. Goldston et al "Institutional Analyses" in F.O. Butrico et al (ed.), Resource Management in the Great Lakes Basin Heath Lexington Books D.C. Heath and Co. Lexington, Massachussetts. 1971 pp. 47-62 at p. 48.

agents in particular". In other words, the Authority is charged with both planning and implementation functions. In carrying out the latter function, however, the Authority is expected to work through the existing machinery of the government.

The Bill goes on to give a detailed breakdown of what the Authority is expected to do in carrying out their more general functions of planning and implementation. The list includes: "to develop an up-to-date long range development plan for the Area; to carry out feasibility studies in the Area; to coordinate and to monitor the various studies of schemes within the Area....; to effect a programme of both monitoring and evaluation of development programmes in the Area; to coordinate the present abstraction and use of natural resources - especially water, within the Area .....; to ensure that landowners in the Area undertake all the measures specified by the Authority to protect the water and soils of the Area; to collect data on water and other resources for planning purposes; to liaise with the Government, the private sector and other interested agencies in the matter of the development of the Area, with a view to eliminating overlap and duplication; to consider all aspects of the development of the Area and its effects on the Lake inflow and outflow[3]......" The list of functions is a long one. But all of it can be reduced to three major functions, viz. planning, implementation and evaluation of the development programmes in the Authority's area of jurisdiction. Primarily however, the major functions of the authority appear to be planning and evaluation. It has no executive authority as all its implementation activities must be carried out through the scheduled ministries.

Functionally, although the accent is on water development the Authority is charged with the broad task of planning for the proper use, conservation and development of the natural resources of the Lake Basin catchment Area for the social and economic benefit of the local people in particular and the nation in general. To be effective, the Authority will have to work very closely (as stipulated in the Bill) with the existing organizations in the area. There will, of course, be problems in the process. The problem will most probably relate to functional domain. That is, to what extent for instance will the Authority participate in the 'traditional' activities of the scheduled ministries (see above) without provoking resistance and hostility.

---

3. G.O.K. The Lake Basin Development Authority Bill 1979 Clause No. 8.

The requirement that projects identified by the Authority be initiated i.e. implemented through the government generally and the scheduled ministries and their agents in particular could create problems especially with respect to priority setting. It could also impair the effectiveness of the Authority if it could not have assay on the implementation timetable financial and personnel control. In this respect, the Authority will be no different from the Ministry of Planning which plans but has no control over what happens in the implementation front.

The stipulation that the Authority will also be involved in implementation and evaluation roles therefore needs a very close definition in terms of who will do what and at what point. This will among other things, involve the definition of manpower utilization and project financing. We will return to this question of working relationships at a later point. For now we examine briefly the major provision of the Bill regarding the structure of the Authority.

THE PROPOSED STRUCTURE OF THE AUTHORITY

The structure of the Authority symbolizes its national and regional character. The membership of the Authority (according to the latest amendments) is to consist of a Managing Director appointed by the President, three permanent secretaries (Economic Planning, Treasury and Agriculture), the two Provincial Commissioners from the area covered by the Authority i.e. Nyanza and Western provinces, and eight other members appointed by the Minister of Planning in consultation with the President. Four of the eight 'ordinary' members will however be people from the programme area.

The Bill is however silent on the power of cooption. The operation of the Authority will traverse the activities of several government departments. It is only proper that a provision be made whereby the Authority may if it so wishes, coopt any person or agency whose participation it may consider critical for the success of its policy making role. It is not enough to assume that such interests may be represented by the eight ordinary members. After all the criteria for selecting them will be, as is often the case with such ministerial appointments, heavily influenced by political considerations - and in some cases even partisan and or sectional considerations. Of the people appointed to the Authority it is of atmost importance that they should be people who can meaningfully and effectively contribute to the making of qualitative public policies. The Managing Director himself should be a man with proven administrative leadership rather than a political 'crony'. That should be an established minimum

essential for the appointment of a Managing Director for any public organization.

The Bill requires the Authority to be convened by the Managing Director at least three times in every year. For efficient and effective functioning of the Authority, it will be necessary and desirable to establish a strong secretariat to monitor the day to day activities of the Authority. The experience elsewhere as well as in this country shows that highly placed official members of such corporate bodies rarely give serious consideration to their membership roles. We had a very unfortunate experience in this country only a few years ago when a National committee charged with policy making for the Special Rural Development Programme failed to discharge that function and instead surrendered, defacto, that critical role to an understaffed secretariat.[4]

It is gratifying to note that the Bill authorizes the Authority to appoint such other officers as it considers necessary or desirable for the efficient conduct and operation of the Authority (Clause No. 9 (1). It is as yet rather premature to suggest in what fields such appointment should be made. But in order to see the Authority off the ground it will be necessary to effect the appointment of the following officers immediately:

1 - Deputy Managing Director - for day to day administration of Authority activities.
2 - Financial Controller - Accounting and budgetary control
3 - A Regional Planner - for planning and coordination of feasibility studies.

And considering the emphasis given to water development, the 4th appointment should go to a hydraulic engineer with specialization in irrigation matters. Other appointments would then follow if and when necessary.

The secretariat of the Authority should be located in the development area, and as many meetings of the Authority as are possible should be held in the area. The advantages involved are many. One very important one is that the policy makers will be close to the scene of action and could at the spur of the moment choose to physically visit project sites if that would help in reaching a particular decision. Of course it would be necessary to maintain an office in Nairobi for the chairman, but the activities in that office should be skeletal - only providing a working

---

4. For more on this see W. Ouma Oyugi Managing Integrated Rural Development in Kenya. Paper Read at the AAPAM Menjul 1977.

base for the chairman while he is in Nairobi on duty. It is assumed here that following recent amendments in the Bill, it will be necessary to appoint a non-executive chairman.

There is also provision for a committee system. The Bill provides that the Authority may from time to time appoint such committees, whether of its own members or otherwise as it may think necessary but that no decision of any committee shall be effective unless it has been confirmed by the Authority. (Clause No. 7). Indeed that is as it ought to be. No organization of the like can operate well if it did not benefit from more considered recommendations of specialized committees. The Bill is however silent on the nature of these committees - whether of standing or adhoc nature.

Whatever form they take, the committees should become the arena where detailed and professional and technical matters partaining to the planning and development of the area are tackled. The cooptation system which we recommended for the Board of Directors of the Authority above is one way of ensuring that expert advice is availed to the Authority. At the committee level it will be necessary to coopt a few professionals involved in the area in which the committee has to deliberate or report. There are areas where it may be necessary to establish standing committees e.g. Finance. Otherwise most of the committee activities should be adhoc.

On financial matters, the Authority is vested with a lot of discretion regarding the use to which funds will be put. The Authority will also be free from routine Treasury Control. The source of Authority funds are the Treasury (voted by Parliament) loan approved by the Minister of Planning and any money accruing to the Authority from any other sources. The delegated financial powers are however subject to the general government accounting and auditing control. At the end of each year, the activities of the Authority and its financial statement will be presented to Parliament for discussion. Auditing of accounts will be by the Auditor General. The administrative-financial controls that the Treasury normally exercises over government ministries will however not be there.

At this juncture it may be appropriate to ask whether the Authority has been endowed with sufficient authority to enable it to be an effective vehicle for development in the lake Basin area. As presently constituted, the Authority appears to be possessed of those kind of powers which are known to have been significant in bringing about success in similar programmes.

I have in mind for instance the experience of the Tennessee Valley Authority in the U.S.A. Studies carried out by academics and practitioners alike have attributed its success to the facts that

1. The Agency was permitted the freedom to make significant decisions on its own account. In otherwords, it had managerial autonomy.
2. The Agency was given responsibility to deal with resources as a unified whole. This involved basing the activities of the Agency upon the natural unity of a region as an area of operation in resource development.
3. A policy fixed by law that the federal regional agency work cooperatively with and through local and state agencies i.e. the partnership of TVA with local government.[5]

Furthermore the location of the administrative control was in the area of operation.

Selznick points out that the TVA recognized right from the beginning that managerial autonomy was critical to its successful operation. The Authority insisted that if effective decentralization was to be achieved the organization had to be permitted to retain real administrative powers unhampared by the administrative controls ordinary exercised over government departments. It further argued that the stringent controls over personnel and financial policy normally exercised by civil service and budgetary agencies represented a cultural lag, still attuned to a government structure limited in scope and essentially parasitic rather than playing a significant positive role in social and economic life.[6]

The administrative freedoms which the agency considered necessary for managerial autonomy which it sought and were granted to it were:

1. Freedom from control by the Civil Service Commission, so that it could avoid the employment of hostile men for key administrative posts.
2. Freedom from control by the General Accounting Office.

---

5. See Philip Selznick T.V.A. and the Grassroots Jar'er Torch Books (paperback) Harper and Row, New York 1966 pp. 28-36 David E. Lilienthal TVA: Democracy on the March Harper and Brothers, N.Y. 1953.

6. Selznick TVA and the Grassroots op.cit. p. 29.

3. Freedom to apply revenue to current operational expenses. It was the position of the TVA that its freedom from congressional allocations and appropriations permitted management to make adjustments in terms of needs as they arose and changed, with an eye to overall efficiency rather than to the terms of the budget.

Another lesson of experience is that of Wabash River Development Authority (Also in the United States of America) here too the agency was vested with a lot of powers in the areas of managerial control and decision making. These, it was claimed, contributed to its successful operation.[7]

The issue which seems to be involved here is one of meaningful decentralization versus symbolic decentralization. We have established that in the case of the TVA there was full decentralization of authority to the Agency by the US Federal Government and that in many respects it was real and meaningful. In the case of the Lake Victoria Basin Development Authority we have also established that on paper, the Authority appears to be endowed with those kinds of power that are normally associated with real decentralized systems. In the case of the Lake Basin Authority, however, it is still rather premature to discuss it interms of successful or unsuccessful case of real decentralization.

The Quest for Autonomy. At this juncture, it may be necessary to assess the limitation that the various stipulations in the Authority Bill may impose on its 'autonomy' and effectiveness. It has been suggested by the critics of the Bill that it does not provide for enough autonomy for the Authority (This came up repeatedly at the preparatory seminars at the University and also in the Parliamentary debates). The question to ask therefore is, what constitutes enough autonomy? Is it meant, by autonomy, that the Authority should have nothing to do with the national system? Does it mean that the Authority should be free to act independent of the broader national development policies? Or does it mean the freedom of the Authority to choose its own Board of Directors?

In the context of public organizations, autonomy is a relative notion. It is relative in the sense that every public organization owes its existence to a superior organization which establishes it for a specific or specific reasons. It is the interest in ensuring that the new organization fulfills

7. Walter M. Philips "The Executive Function in Water Resource Planning in Boyce R.R. (ed.) Regional Development and the Wabash Basin University of Illinois Press, Urbana 1964 pp. 157-165.

its objectives that makes the superior organization want to continue to exercise some form of control over the new one. In a situation where the superior organization provides most of the resources needed by the new organization, that control becomes inevitable. The new organization cannot therefore be expected to act as though it were an independent entity. The question therefore becomes one of establishing the nature of control and autonomy that is desirable and feasible.

In the case of the Lake Victoria Basin Development Authority, it is in the interest of development in the area generally that the Authority maintains close working relationships with the national institutions until the project has at least "taken off' and can then operate on its own generated resources. What that means is that in policy making front, the Central government will have to be represented. To the extent that the funds will-at least initially - come mainly from Central government sources, the auditorial role of the Auditor General's office cannot be avoided. Nor can the role of Public Accounts Committee of Parliament.

I have claimed above that as currently constituted, the Authority appears to have sufficient relative authority to enable it to function well within the functional limits imposed by the Act.
To sum up, the Authority has

(1) freedom to make decisions regarding its activities within the broad policies laid down by the Board - (Managerial autonomy)
(2) freedom to commit resources according to their own priorities
(3) freedom to recruit own personnel and to create organizations necessary for programme effectiveness.

But it has also been pointed out that the implementation role of the authority is limited in that it has to get things done through the relevant ministries. This may appear to be a major constraint but if, as discussed below, the role of the Authority in a given development situation is clearly spelled out (and this does not have to be done in an Act of Parliament) the problem is likely to be reduced immensely. That is all that can be done in the circumstances, for the Authority could not be vested with implementation powers without at the same time removing the said powers from the existing government development and other similar institutions that are already responsible for them.

In addition there are a few aspects of the Bill's provisions that bother the critics. One such provision concerns the membership of the

Permanent Secretaries (PS) in the Board. Many observers argue that their participation will only "help" in suffocating the activities of the Authority since they rarely find time to attend meetings of similar boards where they are members. There is also the fear that because of their relative power position in "the scheme of things" they are in a position to interfere in the day to day running of the Authority etc.

Some of the fears may be founded especially if one remembers the experience of the Special Rural Development Programme (SRDP) cited above. In the case of the LVDA, however, the PSs will not be the only members as was the case with the SRDP coordinating committee. It should be pointed out here that in practice PSs rarely attend board meetings. The usual practice is to designate a senior officer (such as an under secretary) to be in-charge of a given number of parastatals. It is assumed that such an officer, relatively speaking, would have the time to attend to his board duties. Under a strong PS the delegation system should work well.

It should not be forgotten also that a formal organization may do a lot of things which are not necessarily provided for in the official organization charter. Organizations rarely work according to their formal structures. Once in operation, organizations have to take into consideration the limitations imposed on them by their immediate task environment. Dill has defined task environment to denote those parts of the environment which are relevant or potentially relevant to goal setting and goal attainment.[6] In his study of two Nowergian firms, he found their task environment to be composed of four major sectors. (1) customers (both distributors and users); (2) suppliers of materials, labour, capital, equipment, and work space; (3) competitors for both markets and resources and (4) regulatory groups, including governmental agencies unions, and interfirm associations. The firms studied were private ones, but the concepts employed are useful enough in helping us to analyse any kind of organization. In the case of Lake Basin Authority it will also have to take note of the presence of (i) its immediate customers or clients (i.e. the people of the Lake Basin development area) (2) the suppliers of material, labour, capital equipment and work space. (e.g. Central Government and County Council) (3) its competitors for both market

---

6. Dill William R. "Environment as an Influence on Managerial Autonomy" Administrative Science Quarterly Vol. 2. March 1958, pp. 409-443 quoted in J.D. Thompson Organizations in Action McGraw Hill New York 1967, p. 27.

and resources (i.e. government and non-government organizations in the area.) (4) the regulatory agencies (mainly government). If therefore, we have to assess the potentiality of the Lake Basin Authority as an agent of national development, we must examine its environment and how it is likely to interact with it. Before that exercise can be undertaken, however, it is pertinent here to discuss the existing organizational structures within the area that are likely to be interested in the activities of the Authority.

THE EXISTING INSTITUTIONS IN THE DEVELOPMENT AREA

The existence of other institutions of development in the area is recognised in the Bill. In fact, the Bill specifically stipulates that the Authority shall initiate project activities identified in the planning process 'through the government generally and the scheduled ministries and their agents in particular'. What is the structure of field Administration in Kenya that bears directly on the issues in hand?

The present Field Administrative structure in Kenya has been built on a system which was inherited at independence. During colonial rule, the structure of Field Administration was characterized by functional differentiation and departmental independence. Government departments were hierarchically structured. In a number of departments (e.g. Agriculture and Health) the hierarchy of authority ran from the departmental headquarters down to the location and sub-locational level. Decision making was similarly structured. Most of the important decisions whether of policy or operational nature were centrally determined, and subsequently channeled down the line. Field level organizations were seen merely as appendages of the Central authority that had to act in a certain predetermined manner. There was little or no room left for adjusting policies to local needs or demands.

At every administrative level (i.e. Province, District, Division, Location, Sub-location) a "generalist administrator" was put in charge. Such Officers functioned within the framework of Provincial Administration. They were, for purposes of political control and coordination, the "team leaders" in their respective administrative areas. They acted as chairmen of various inter-departmental committees - both developmental and non-developmental. But they lacked functional authority over the individual departments. Such authority as was necssary for carrying out a particular development function, the individual departments received from their internal hierarchical systems. A Provincial Commissioner (P.C.) or his District Commissioner (D.C.) was mainly concerned with the general political stability in his area of jurisdiction.

The system has not changed much since independence in spite of the concerted efforts by the Government to integrate the activities of government agencies in the field. The individual departments still enjoy a lot of autonomy - especially as regards their technical - professional activities. This autonomy has however been subjected to a lot of pressure since the recent past.

Besides the Government institutions in the field, there are also a number of non-governmental institutions in the field that also participate in development activities. The list include, Commercial Banks (for Development loans) international agencies, voluntary organizations and popular institutions (e.g. Cooperatives and self help committees) several parastatals and statutory Boards. Efficiency in the system output requires that the activities of all these institutions be systematically coordinated. This is the task that the Development Committees in the field have been charged to grapple with. Understanding of how these committees have worked so far is important for the analysis of the potentiality of the Lake Basin Authority as an agent of national development.

The Provincial and District Development Committees about which a lot has been written already,[9] were established between 1966-1970 to "coordinate and stimulate development at the local level by involving in the planning process, not only government officials but also the people through their representatives"[10]. Since then they are also now required to supervise the implementation of rural development programmes as well as monitoring plan progress.

As currently constituted, the development committees (both provincial and district) are made up of heads of departments concerned with development as well as the MPs from the area. In the case of the District Development Committees (DDCs) there is also provision for nomination of a few prominent local people by the chairman (i.e. the D.C.). The County Council is also represented at the DDC by its Chairman and Clerk to Council.

---

9. Eg. R. Jackson "Planning, Politics and Administration in G. Hyden et al Development Administration the Kenyan Experience Oxf. University Press Nairobi 1970 especially pp. 191-200; C. Gertzel "The Provincial Administration and Development in Kenya". Proceedings of USSC Dar es Salaam 1970; Njage Nthiga Management of Rural Development Fund in Kenya: M.A. Thesis Dept. of Govt. University of Nairobi 1978.

10. Republic of Kenya: Development Plan 1970/74 p.75.

In establishing these committees, the Government hoped that henceforth government officers in the field would begin to see development as an integrated process. The departmental activities were to be seen in the context of how they contributed to the overall development of the rural areas. The resources were to be dealt with as a unified whole through a system of coordinated activities. In 1975/76 the Government appointed in each district a District Development Officer (DDO) to help strength district planning and general coordination of development activities in the district. At the Provincial level the Provincial Planning Officers (PPOs) had been appointed between 1968-1970 to carry out simila activities. The experience has however, been a mixed one.

The experience has shown that the effectiveness of these committees has been impaired by the structural constraints inherent in the Government system.[11] The departmental heads have been very reluctant to accept the authority and guidence of the Committees. The headquarters officers have also been reluctant to delegate discretionary powers to field agencies. In some cases the effectiveness of these committees have been hampered by the attitude of the individual District or Provincial Commissioners. No meetings can be held unless by them. Where a D.C. or P.C. is not development oriented, meetings are rarely convened. These attitudes have also affected the efficiency of the DDOs. The DDOs have been made responsible to the DCs in carrying out their development roles. Where a D.C. is not committed to the task of development, a DDO is merely used as a political officer in replacing DOs on leave, writing monthly reports, etc.[12]

The point I have been trying to make here is that as currently constituted, the government institutions in the field are ill structured for the purposes of integrated development activities. There has not been genuine decentralization. The inter-department Committee system has not worked well. Indeed it rarely does. Writing about an American experience David Lilienthal once observed.

11. For more on this see, in addition to the sources cited above (Ftn No. 9) R. Chambers Managing Rural Development Scandinavian Institutes of African Studies Uppsala 1974; IDS, University of Nairobi, 1st Evaluation of the SRDP. Occasional Paper No. 8 1972. Also 2nd Evaluation, Occasional Paper No. 12, 1975 especially Ch 19; W.O. Oyugi Decentralization for Rural Development; Lessons from Kenya. IDS, University of Nairobi, Working Paper No. 255, 1976 Jan.

12. I have witnessed a lot of this during my field trips.

> It is not decentralization nor genuine regionalism to set up an inter-agency committee as has been done in the Missouri River Basin, each of the members of the Committee being responsible to a different and separate Washington Department or bureau.[13]

Such a structure he felt (quoting from a government report) could not see to it that the basin (Missouri River Basin) is a Unit for coordinated management. It could only encourage centralization and the habits of dependence on centralized authority and largesee.[14] In relating its activities to those of the existing central government institutions in the area, the Lake Basin Authority will have to take note accordingly.

The other institutions in the Lake Basin Development area are equally weak. I begin with the Local Government System in the area. Here (in Nyanza and Western Provinces) as elsewhere in the country, the system of Local Government is weak.[15] This weakness is again structural. No major decisions regarding policies, appointments, commitment of resources, for instance, can be executed without written approval of the Ministry of Local Government. In addition, the weakness lies in the inability of local authorities to develop stable resource bases. This has inevitably led to their dependence on the Central Government for financial assistance. Consequently this has become a major weapon which the Central government has used in controlling the behaviour of local authorities especially of the very poor ones. Furthermore, and largely arising from their state of isolvency, local authorities do not have effective internal organizations. They have few or no staff in the field (excepting market attendants) because more often than not, they cannot afford to maintain them. The general weakness of local authority system means therefore that if the Lake Basin Authority were to work through them, the activities of the Authority would only be suffocated.

We have also mentioned the existence in the area of a few private and quasi government institutions involved in development activities. There organizations usually operate on guidelines centrally set. The lending policies

---

13. David E. Lilienthal T.V.A.: Democracy on the March op.cit. 145

14. Ibid. p. 154.

15. For a more detailed discussions W. Ouma Oyugi Local Government and Development in Kenya. Discussion Paper No. 131 Sussex, Institute of Development Studies April 1978.

of all commercial banks in the area are centrally determined (in Nairobi and sometimes outside Kenya). Rarely are these guidelines bent to accomodate local demands. The "field" units of parastatals also function along similar lines, with major policies and in most cases, even operational activities, being centrally determined. A regional development agency bent on using the existing local resources and institutions as an integrated whole, thus, finds the structural orientation of such parastatal bodies unsuitable for development purposes.

On the nature of the existing institutions in the Lake Basin Development area this much can be said:

(1) there are several institutions (both public and private) which play one role or another in the development efforts.

(2) Most of these institutions are hierarchically structured.

(3) By their very nature, therefore, these institutions are not suitable as instruments of national and local development.

The authority Bill stipulates nevertheless that projects identified as a result of the planning activities of the Authority shall be initiated "through the government generally and the Scheduled Ministries or their agents in particular". It further states that the Authority shall "maintain a liaison between the Government, the private sector and other interested agencies in the matter of the development of the development area with a view to limiting the duplication of effort and to ensuring the best use of the available technical resources". The fact that the existing institutions are weak and the requirement that the Authority should utilize them in carrying out its development activities therefore creates a real dilemma for the new organization. How the two, i.e. the Authority and the existing organizations can be made to collaborate and to function effectively is the subject of the discussions that follow.

FUNCTIONAL RELATIONSHIPS

Most of the functions which the Lake Basin Authority is expected to perform are being performed in one way or another by the existing institutions in the area. Care should therefore be taken right from the beginning, to ensure that the area of conflict between the Authority and the existing institutions is minimized as much as possible. One way of doing that is by defining as closely as possible the domain of the individual organizations in the development area. That is, there is a need for agreement or a consensus about who should do what and where in the development area. Domain consensus is important because

it defines a set of expectations both for members of an organization and for others with whom they interact, about what the organisation will and will not do.[16] It also provides, although imperfectly an image of the organizations role in a larger system, which in turn serves as a guide for the ordering of action in certain directions and not in others.[17]

It has been established above that the major institutions existing in the Lake Basin development area are: Central Government departments, development committees, local authorities, public corporations and Boards and private institutions. What should be the nature of relationships between the Authority and those organizations in the development efforts?

To start with, the Authority should be engaged in carrying out those essential functions that the existing organizations have been unable to perform well and those which they have been unable to tackle at all. There is a need for functional differentiation for, if the Authority were to be engaged in the routine activities of government such as those normally engaged in by government departments, the Authority would loose a distinctive character. It would also be difficult to differentiate it from other government organizations. Furthermore it could simply become a source of conflict within the government system in the process of trying to implement development policies. The paper by Dr. Wanjiku Muiruri is also very critical in this respect. She writes

> In terms of rural grassroots strategy as spelled out in official documents, it appears at this stage that the creation of LBDA will at best be a duplication of already existing policies. - until and unless real existing policy gaps have been identified and related to it.

Relationship with the Ministries

The functions of the Authority in the fields of planning, implementation coordination, review and evaluation cut across the activities of many departments. To establish a smooth working relationship, it will be necessary to establish in what areas of departmental activities, the New Authority can create the most impact. Pinpointing the areas of departmental inadequacies could also help in the task of differentiation of functions that we suggested above. In the case of some departments such as Agriculture, the activities of the New Authority could be limited to a geographical area e.g. river valleys and Lake shores. In this case, the Authority would be primarily concerned with

16. See James D. Thompson Organization in Action op. cit p. 29.
17. Loc. cit.

irrigated agriculture. This emphasis is discernible from the Authority Bill in which out of the thirteen stipulated functions seven directly relate to the utilization of water resource for development.

But there are also areas where functional overlap would be unavailable. Irrigation work is a case in point. Presently minor irrigation activities are carried out by both the Ministry of Water Development and the Ministry of Agriculture. The lagger schemes are however the responsibility of the National Irrigation Board. Here for example the Authority will have to work very closely with the Water Department which is responsible for water assessment rational allocation of water to alternative uses and water abstraction.

The point being made here is that there is a need to distinguish, where possible, between the activities of the authority and those of the regular government departments; that where that distinction is not feasible, the nature of the interdependence should be determined. One way of doing that as was suggested above is the establishment of domain consensus. It would go along way in narrowing the area of inter-organizational conflict. Using the example of irrigation again, the LBDA could specialize in large scale irrigation thereby leaving minor irrigation schemes to the other agencies.

One point which should be borne in mind is that organisations do not change the environment around them at will. There is usually a tendency on the part of the old "well established" organizations to resist new comers to the system. This resistance, the Lake Development Authority should expect from the existing government departments. One of the most critical department in this regard is the Provincial Administration. We discuss presently the role it is likely to play in the life of the new Authority.

The Provincial Administration in Kenya is currently responsible for the general coordination of government activities in the field. No project that is openly opposed by this department can succeed. If therefore, the new Authority is to succeed, it will have to establish harmonious working relationships with the Administration. Some of the functions the Authority is expected to carry out in it cannot do so without this support. For instance the Bill states, "The functions of the Authority shall be ..... (h) to ensure that landowners in the Area undertake all the measures specified by the Authority to protect the water and soils of the area". There is an enforcement function implied here; and that function in the Kenyan context can only be performed by the Provincial Administration. To be assured of full support for the Authority's activities by the Provincial Administration, it will be necessary and desirable

for the Authority to coopt them as appropriate into its decision making system. Cooptation according to Phillip Selznick enables the organization to absorb new elements into the leadership or policy determining structures of an organization as a means of averting threats to its stability or existence.[18] This, the Authority will have to do, not only to the Provincial Administration, but also to other interested institutions in the area.

Relationship with Development Committees

The present weaknesses of these committees were discussed above. Considering that their activities cover the "development area", it will be necessary to ensure that such activities do not incapacitate the new Authority in discharging its development functions. One way in which the new Authority can help to strenthen these committees is by assisting in coordinating their a activities in close collaboration with the District Development officers in their respective districts.

The District Development Committee will continue to be the most important coordinating planning committee in the district. Accordingly the development programmes of the Authority will have to be incorporated into the District plans. This can be done without impairing the effectiveness of the Authority. What is important however, is that in the planning process, the Authority and the individual departments should keep one another informed of what they propose to do in any given planning period. This can be done through the DDOs or through the Provincial Planning officers as is appropriate. The Authority would have to be represented in the Development Committees as I understand (still subject to verification) is the case is the Tana River Development Authority.

Relationships with Local Authorities

The weaknesses of rural local authorities on matters partaining to development have been discussed. The weakness even threaten the very existence of these bodies. I expect them to continue in that state of affair for sometime to come. Since their role in rural development is rather marginal, it is unlikely that their "activities" will affect those of the new Authority much.

---

18. Phillip Selznick, TVA and the Grassroots op. cit p. 13.

Urban local authorities on the other hand are centres of development activities. Most of the power supplied in this country is consumed in the urban areas. The same is true of piped water and many other services. It will therefore be necessary and desirable to coordinate the urban physical plans with those of the Authority. Again the DDO is the arena for such coordination.

Relationships with other Institutions in the Area

As was mentioned earlier, there are also a number of other institutions apart from those of the government that participate in rural development activities. As the Bill itself provides, it will be essential to coordinate the activities of these institutions with those of the new Authority. In the field of irrigated agriculture, for instance commercial banks could continue to provide loans for specific crop developments within the broad guidelines set out by the Authority e.t.c.

There is also the relationship with the popular institutions to consider. I have in mind here the relationship with the cooperative societies and with the self-help committees in the development area. A mojar problem of cooperative societies in Kenya is managerial in nature. Here is one area where the Authority can assist by providing technical advice. It will be in the Authority's own interest that these institutions are strengthened since they handle the marketing of quite a few agricultural commodities (.cotton and coffee).

Another problem the new Authority will have to grapple with is how to relate the self-help activities in the area to those of its own. This will not be an easy task if the people do not see themselves to be benefitting from the activities of the Authority. To win the confidence and hence the willing participation of the local people in development if and when that is needed, the new Authority will have to create an impact in the area. That it can do by providing the essential services or basic needs hitherto lacking in the area. It will also be necessary to involve the people in one way or another in the decision making about those issues that are of direct concern to them e.g. land acquisition.

In short, the point being made about the relationship between the new Authority and the existing institutions in the area is that there is a need for functional differentiation. Where overlap is unavoidable there is a need to identify the nature of interdependence. It is only by so doing that inter-organisational conflicts can be minimized.

SUMMARY

The paper has been concerned with the analysis of the organizational relationships which are likely to emerge in the Lake Basin area as a result of the establishment of the Lake Basin Development Authority.

The nature of the functions of the Authority will to a large extent influence the pattern of interaction that emerges in the development area. The functions of the Authority broadly defined include planning, implementations review and evaluation of development programmes in the Lake Basin catchment area. These functions cut across the activities of the existing organizations in the area. To reduce the area of conflict between the Authority and the existing organizations, it will be necessary and desirable to establish the domain of each participating organization. Where it is not feasible to do that it will all-the-same be a essential to determine the nature of interdependence.

As proposed, the internal structure of the Authority symbolises its national and local character. A few senior government officers as well as appointed local people make up a Board of 14 members. The Authority is also empowered to create committees if and when necessary.

It is recognized in the paper that the key government appointees in the Board (i.e. the Permanent Secretaries) are usually too busy to find time to attemd meetings outside their own ministries. It will therefore be necessary for the Authority to establish a strong secretariat to give it the strength it needs to function. In this connection the appointment of key personnel in the major areas of activity will be one of the first tasks the Authority will have to grapple with.

Is the Authority endowed with sufficient powers to carry out its functions? On paper, the Authority is vested with a lot of discretionary powers in the fields of decisionmaking, recruitment and the commitment of funds. But organizations rarely function according to how they appear on paper. There are many factors in the organization's task environment that influence its behaviour.

The new Authority will have to contend with the power and influence of the existing institutions in the area. It ill also have to take cognizance of the general organizational weaknesses in the Kenyan Field Administration. To avert any threats to its own survival the Authority will have to employ

the strategy of "Cooptation". In order to minimize the area of conflict, the new Authority should concentrate its activities on those areas where the existing institutions are either weak or have made no attempts at all. In order to get the support from the existing Institutions in the area, the activities of the Authority should be seen to be complementary rather than competetive with those of the existing Institutions.

With regard to popular support, the new Authority will have to demonstrate that it is in a position to provide the basic service hitherto lacking in the area. But even before that can be done, it will be necessary to ensure that the establishment of the Authority in the area does not result in personal losses on the part of the local population.

It is not possible to live in the future with certainty. What this paper has therefore attempted to do is to sketch out the future of the new Authority in the light of what is known about organizational behaviour. Research would have to be done after the establishment of the Authority to meaningfully grapple with some of the issues raised in this paper.

REFERENCES

1. F.A. Butrico et al (ed) Resource Management in the Great Lakes Basin Health Heath Lexington Books. Massachusetts 1971.

2. Republic of Kenya: The Lake Basin Development Authority Bill 1979 in The Kenya Gazette No. 32 Bill No. 8, May 25, 1979.

3. W. Ouma Oyugi Managing Integrated Rural Development in Kenya. Paper read at the African Association of Public Administration and Management (AAPAM) Panjul. Gambia Nov. Dec. 1977.

4. W. Ouma Oyugi Local Government and Development in Kenya. Sussex, IDS Discussion Paper No. 131. April 1978.

5. W. Ouma Oyugi Decentralization for Rural Development: Some Lessons from Kenya, Nairobi, IDS Working Paper No. 255, Jan 1976.

6. P. Selznick TVA and the Grassroots Harper Torch Books (Paper back) Harper and Row, New York, N.Y. 1966.

7. David E. Liliethal TVA. Democracy on the March Harper and Brothers New York. N.Y. 1953.

8. Bryce R.P. (ed) Regional Development and the Wabash Basis. University of Illinois Press. Urbana 1964.

9. J.D. Thompson Organization in Action McGraw Hill New Yorks, N.Y. 1967.

10. G. Hyden et al (ed) Development Administration the Kenya Experience Oxford University Press 1970.

11. C. Gertzel The Provincial Administration and Development in Kenya. USSC Dar es Salaam 1970.

12. Nthiga, Njage the Management of Rural Development Fund in Kenya Unpublished M.A. Thesis. University of Nairobi, Department of Government. 1978.

13. R. Chambers Managing Rural Development Scandinavian Institute of African Studies. Uppsala 1974.

14. I.D.S. University of Nairobi 1st Overall Evaluation of the SRDP Occasional Paper No. 8 1972.

15. I.D.S. 2nd Evaluation of the SRDP Occasional Paper No. 12 1975.

16. R.D. Ogendo-Resource Base(s) For Integrated Industrialization and Development in the (Kenya) Lake Victoria Basin, IDS Seminar Series on Lake Victoria Basin Development (Series No. 20) July 1979.

17. Wanjiku Muiruri The Lake Victoria Basin Ecological Land Productivity as A Critical Policy Issue.

I.D.S. Seminar Series on Lake Victoria Basin Development (Series No. 9) May 1979.

COMMUNICATION AND INFRASTRUCTURE IN THE LAKE VICTORIA BASIN OF KENYA

By

Peter W. Wambura
Chief Executive Engineer
Roads Department, Ministry of Works

1.0 INTRODUCTION

In the current 1978/79 - 1982/83 Fourth National Development Plan, the Kenya Government lays emphasis on rural development, and the major theme of the development programmes as outlined in the said plan is the alleviation of poverty throughout the country. In pursuit of this objective and in particular the implementation of rural development programmes, it is stipulated that the development of the country should be both diversified and dispersed. This will result in as many people as possible being involved in the undertaking of economic and social development activities which are likely to generate high incomes. This could come about as a result of utilising the three related and mutually supporting development efforts which are capacity utilisation, employment creation and rural development.

In pursuance of the stipulated Government policy of alleviating poverty among the rural masses throughout the country and at the same time dispersing and diversifying development programmes which could open up the economically potential but untapped areas, and enhancing the development of those regions which have already taken off, H.E. President Moi, while addressing a mammoth public rally at Kisumu in December last year, directed the Vice President and Minister for Finance and the Minister for Economic Planning and Community Affairs to establish the Lake Victoria Basin Development Authority with a view to enhancing the development programmes in the Lake Region as well as harness the waters of all rivers draining into Lake Victoria. The Lake Region is an agriculturally potential area and as such the Authority will be faced with the task of harnessing and using water as a basic natural resource for beneficial uses such as irrigation during drought times.

The development activities of the Lake Victoria Basin Development Authority will not only be confined to the lowlands or plains surrounding Lake Victoria but will also cover the entire catchment areas which normally drain into the lake. Therefore the authority will have to look into the Management of the waters of the rivers draining into the lake to prevent floods through storage.

The Authority is likely to concentrate its activities in Nyanza and Western Provinces but it will also extend its activities to parts of the Rift Valley Province as far as Kericho and Nandi districts. Thus, the Authority will cover nine districts while undertaking its development programmes and these will include Kericho, Nandi, Bungoma, Busia, Kakamega, Kisii, South Nyanza, Kisumu and Siaya.

Although the Authority will basically be concerned with the management of water as a basic natural resource and using it beneficially in such uses as irrigation and the generation of hydro-electric power, it will have to assess how best the available natural resources will be utilised so as to enhance and promote the agricultural and industrial development of the Lake Victoria Basin. The Lake Region constitutes the sugar belt of Kenya and many other cash crops such as tea, cotton, pyrethrum etc. are grown within the area.

The Lake Victoria basin region has a high agricultural potential, and agriculture being the mainstay of the Kenyan economy, this agricultural potential needs to be exploited maximumly for the benefit of not the local population but for the whole country as well. It is needless, to emphasise that the resulting agricultural produce will not only generate high incomes for the local Mwananchi but will enable the country to earn the much needed foreign exchange by increasing agricultural exports. The resultant high incomes will of cause result in raising the standard of living of the rural population and consequently creating a demand for other infrastructural services such as electricity, piped water, recreational facilities etc. which will provide extra benefits to the rural population.

It is of utmost importance, to note that the agricultural potential of the region will not be fully utilised without an efficient all-weather access system. The local Mwananchi will not therefore derive the envisaged benefit unless his access needs are satisfied. Therefore, it is vital to note that adequate and all-weather access is a basic requirement for the realization of the said development, because an efficient and all-weather access would result in quicker, cheaper and efficient transportation of goods and people to and from service centres and would provide reliable access to market places where farm produce would be sold.

As far as the fishing industry is concerned, the Lake Victoria portion of Kenya has a potential of yielding nearly 30,000 metric tons per annum, and the Kenya Government intends to exploit this potential during the current development plan by developing mechanized trawling fleets on Lake Victoria and the improvement of traditional fishing methods by the provision of motorized boats, improved fishing gear and fishing practices. Fish farming, which is mostly situated in the densely populated and fish-consuming Nyanza and Western Provinces, will be reviewed and promoted. To implement the laid down fisheries stategies, especially for the inland fish farming, a basic and necessary condition is quick and cheap means of transportation. This can only be provided by all-weather access roads.

The Lake Victoria Basin has the potential for a lucrative tourism industry. Recently a number of tourist class hotels have been constructed through the assistance of Kenya Tourist Development Cooperation, and these included, among others the Kisumu Sun-Set Hotel, the Homa Bay Hotel, and the Bungoma Hotel all of which are intended to serve the planned Western Kenya Tourist Circuit within which lies the Lake Victoria Basin.

Needless to stress, the importance of reliable and all-weather access in the promotion and development of the tourism industry can not be over emphasized. All-weather access is a necessary condition to enable tourists to visit various tourists sites, such as those in the Lambwe Valley and around Lake Victoria, with ease, convenience and safety. Also all-weather access will, apart from supporting and sustaining the already established tourist attractions, enhance the development of tourism in the potential but not yet tapped areas.

This paper therefore endeavours to examine the role communications infrastructure will play in enhancing the envisaged development programmes within the Lake Victoria Basin and its surrounding catchment areas. The communications infrastructure system includes the various channels and modes available for facilitating the exchange of messages and information and the transportation of people and goods. The elements that comprise the integrated communications network include, of course, the mass media and the postal services which are used in the dissemination of information and dispatchment of messages and parcels, and the major technical modes which include roads, railways, air transport, maritime and inland water transport. Although collectively, the various elements and modal components perform the essential function of communication and transportation so necessary in all economic and social development efforts, the road network plays a major part in satisfying

the transportation needs of society because of its great versatility to reach almost every part of the country and its ability to facilitate reliable, convenient and relatively cheap means of transporting goods and passangers from one area to another, Therefore, before I proceed to examine the role played by a road network in enhancing the development of a rural area in general and the Lake Victoria Basin particular, I find it fitting to give a brief description of the existing transport system as regards rail transport, air services and inland water transport within the areas served by the Lake Basin.

The Kenya railway system constitutes the second most important mode of transport in the country. The railway network covers 2114 kilometres, comprising of one mainline extending 1086 kilometres from Mombasa via Nairobi to the Uganda Border, and 1028 kilometres of branch lines.

The main branch line which, in addition to the Nakuru-Malaba Section serving the Lake Basin, is the Nakuru - Kisumu branch line. The Kisumu branch line extends up to Butere and there is another branch within the Lake Basin extending from Eldoret to Kitale.

In the current 1979-83 Development Plan, it is envisaged that the railways will become the main mode of long distance transport for both cargo and passengers as well as becoming the main carriers of traditional agricultural goods, such as maize, coffee, etc, for distances greater than 100km. In pursuit of these objectives, it is planned to implement railway extensions in the country that are determined to be economically viable In the Lake Basin, railway extensions have been planned for the Butere - Bungoma and Lumbwa - Sotik - Kisii - Homa-Bay with a Railway Terminal at Homa Bay. Feasibility studies have already been carried out for the Butere - Bungoma extension and the railway terminal at Homa Bay, while detailed feasibility studies will be undertaken on the Lumbwa - Sotik - Homa Bay extension.

Air transport in Kenya could be considered to be still at its early stages of development, as there are only two international airports in Kenya situated in Nairobi and Mombasa, with medium-sized aerodromes in Kisumu, Malindi and Wilson Airport in Nairobi. There are also a number of small airstrips at certain strategic areas which, with the three medium-sized aerodrome at Kisumu, Malindi and Wilson Airport, handle Charter flights.

Around the Lake Victoria Basin, there is one main Aerodrome situated at Kisumu with other airstrips situated at Eldoret, Bungoma, Homa Bay, Kisii,

Kakamega, Kericho and Kitale.

In the current 1979-83 Development Plan the Kisumu Aerodrome will be improved so that Kisumu and hence the Lake Basin will be included in scheduled flights by Kenya Airways. Emphasis will also be given to the development of minor airstrips located in highly populated areas with important administrative and commercial centres. Under this programme, the airstrips at Kitale, Kakamega, Kapsabet, Webuye, Kisii and Homa Bay will be improved to minor airports and hence expand the regular airline route network. This will help greatly in improving the air transport within the Lake Victoria Basin and will enhance the development of agricultural programme such as horticultural activities which will require fast transportation.

Inland water transport is provided on Lake Victoria at Kisumu as the only inland waterway of Kenya. The Kisumu inland waterway set-up used to operate steamer services between Tanzania, Kenya and Uganda, but due to the break up of the East African Community, the Lake Steamer now serves only areas between Homa Bay, Kendu Bay and Kisumu.

The combined effect, of all these modes of transport when fully developed and implemented, is the realisation of an effecient and quick transportation system, and increased awareness of the local population. This will encourage the wananchi to diversify their economic endeavours, and embark on economic activities likely to generate high incomes.

2.0 THE ROAD NETWORK IN KENYA

2.1 General Background

The road as a mode of transport is today the most vital of all modal components when evaluated in terms of extent, reach and service to community. The Kenyan Highway system consists of a highly diversified network of road links ranging from little more than forest trails which are accessible only during the dry season to well-engineered multi-lane tarmac carrying heavy volumes of traffic. With few exceptions, the main roads of Kenya provide access to all regions of the country and constitute a well integrated network of national and regional roads consisting of classified as well as unclassified roads.

2.2 The Sequential Development of the Road Network Under the Previous National Development Plans (1963 - 1978)

The historic development of the Kenya road network undoubtedly extends back several hundred years when many roads were improved as caravan and tribal trails and tracks. However, efforts to improve the road network as we see it today to a modern level of standard began around 1959, and following this period a series of stages of system development have been carried out. The early road development programmes (Plan for Road Development 1963-1968) concentrated on upgrading Trunk roads to engineered bitumen and gravel standards. The succeeding road development programme (proposed Kenya Road Development Plan 1969/74) laid major emphasis on the development of feeder and other minor roads in the rural areas and requested for funds for road construction of over £43 million for the five year period which greatly exceeded those requested for the period 1963/68 of K£17.6 million. This was in pursuit of the objectives of the 1969-74 road development programme as outlined in the National Development Plan which stated as follows:

> ..... Major emphasis is being directed towards feeder and minor roads in the rural areas. New roads will be built to open up areas where no road communication exists. In other areas, the roads are to be improved even though the present levels of trafic does not always justify the required expenditure on the same basis as for trunk roads. The total road programme for the 1970-74 plan period calls for expenditures exceeding K£43 million based on 1967 prices. The division of expenditures among the various road classes is 34 per cent for feeder roads, 20 per cent for special development roads projects and 46 per cent for trunk roads. The division provided a rational balance among the road classes, recognizing the necessity for upgrading many existing bitumen trunk roads that are heavily trafficked and the broader needs of having the entire road system adequately serving a primarily agricultural economy ... .

In further pursuit of the Government's policy of boosting rural development and realising the role the road network plays in implementing the country's economic development programmes, the road development policy formulated for the 1974-78 plan period extended the development of the road system to a more locally oriented class, still focusing its major activities on the regravelling of secondary and minor roads and the ambitious Rural Access Roads Programme. Under the Gravelling, culverting and Bridging Programme of the Ministry of Works, approximately 10,000 kilometres of classified secondary and minor roads will be improved to all weather status

over a period of seven years between 1975 and 1982, while under the Rural Access Roads Programme, about 16,500 kilometres of farm-to-market non-classified access roads will be constructed to all-weather standards, in addition to selective improvements on the classified network.

2.3 Kenya's Road Development Plans and Programmes during the Current Fourth National Development Plan (1979-1983).

Even though the development of Kenya's road network has up to now proceeded with commendable efforts, the whole exercise of road planning in both developing and developed countries is a continuous process.

At present, the whole Kenyan highway system consists of nearly 150,000 kilometres of both classified and unclassified roads. Of this total, the classified system which is officially under the jurisdiction of the Ministry of Works is about 51,000 kilometres with some 2944 kilometres of special purpose roads which support certain specific development programmes.

Under the Special purpose Roads programme, an integrated and/or a package programme is pursued where a road segment directly related to the development of a specific sector such as agriculture, tourism, settlement etc. will be considered, justified and financed as part of the schemes it is required to support. While implementing this programme, the ministry of works only offers technical assistance in a purely advisory capacity such as carrying out or help in carrying out the required economic and technical feasibility studies, the evaluation and award of contracts, and the supervision of construction with funds earmarked under the client Ministry's budget.

Almost 45 percent of the classified system is made up of the minor roads class, while the trunk, primary and secondary roads account for 55 percent of the total length. Most of the roads are concentrated in densely populated areas of the western and central highlands. As such, it is felt that there still remains alot to be done until such a time as we have achieved our final objective of creating a national network which, by the use of different classes of roads, will provide all-year round access to the whole population, production and consumption centres throughout the country.

Towards this end, the current 4th National Development Plan, covering the period from 1979 to 1983, envisages the initiation of various programmes for the construction and improvement of many more kilometres of various classes of roads which are intended to cater for various categories of traffic and serve a wide variety of people engaged in diverse activities. These programmes range from the upgrading and/or improvement of the heavily trafficked Trunk and Primary Roads, to the improvement of Secondary and Minor Roads and the construction of new Rural Access Roads which will facilitate all-weather access to markets, schools and hospitals and other social service centres in rural areas. Perhaps one of the major highlight in Kenya's o erall highway development efforts during the 1979/83 4th National Development Plan is the fact that the Republic of Kenya has been selected, from among a few Independent African States, for World Bank's First Highway Sector Loan as part of a comprehensive Highway Sector Development Plan. Under this loan, which was concluded recently, the Bank Group will provide funds amounting to US$ 90 million (or Kf 33.3 mill.) for implementing various programmes which include the strengthening, reconstruction and up-grading of major Trunk and Primary Roads and programmes for expanded road maintenance, traffic law enforcement and road safety, where the latter is intended to enhance the safe use of the road network.

While taking into account, the major economic development constraint, which is the availability of funds, and bearing in mind that there are in all forty one districts in the country among which the limited available funds should be shared, the government envisages to rehabilitate and construct nearly 678 kilometres of bitumen roads and 220 kilometres of gravel roads within the Lake Victoria basin during the current development plan. Although, the completion of these road projects will result into an improvement in the transportation network within the region, it is felt that a further improvement in the system will be attained, if subject to availability of development funds, a further 583 kilometres of roads in the region will be improved to either bitumen or gravel standards. The net effect of these envisaged road improvement will of course be a well integrated road network, and consequently an improved, cheap and fast transportation system to and from market centres for both passengers and produce of the region. As a result new economic resources could be tapped whereas the already established economic activities will be fully utilised for the benefit of the country and the lake basin in particular.

Overall, the Kenya government has earmarked a total of about K£203 million for the construction and improvement of roads under the various programmes to be implemented during the 1979-83 Development Plan. In addition, over K£50 million will be spent for the maintenance of the classified roads during the same period.

Needless to say, the initiation of the Highway Sector Loan lending to Kenya is a direct reflection of the World Bank's confidence not only in the government's stated goals and objectives for the whole transport sector, but also in the capacity and capabilities of the Roads Department of the Ministry of Works to successfully implement the various road programmes.

3.0 THE ROAD NETWORK WITHIN LAKE VICTORIA BASIN

The road network in the Lake Victoria Basin, that is within the nine districts likely to be covered by the Lake Victoria Basin Development Authority, constitutes about 11, 100 kilometres of classified and special purpose Roads which is approximately 22 per cent of the whole classified s system. Of this length of roads within the Lake Basin, about 1600 kilometres are of Special Purpose Roads, which are required for the promotion of such agricultural cash crops as tea, sugar, rice, cotton etc. By the end of 1982, it is envisaged that an additional 5150 kilometres of farm access road will have been constructed within the Lake Basin through the Rural Access Roads Programme, which is currently on-going within the nine districts amongst twenty three districts being covered by the programme. The rural access road programme will go further in enhancing the agricultural activities of the local wananchi by providing the much needed reliable access for the marketing of the farm produce. It is needless, to emphasise that through both the Special Purpose Roads and Rural Access Roads programmes, the growing of such crops as tea, sugar, rice, cotton etc. in the Lake basin region will greatly be enhanced.

Inorder for the road network to serve its intended purpose effectively, it should be passable throughout the year, this normally is ensured by the provision of a well engineered drainage system and appropriate structures to the roads. Regular and appropriate maintenance of the roads be they bitumen or gravel is a basic need in addition to good drainage required to keep the road accessable throughout the year. The road system within the Lake Victoria Basin is being improved currently through the Rural Access Roads and Gravelling, Bridging and Culverting programmes both of which are

endeavouring to construct roads with adequate drainage and structures. These two programmes are supplementing the activities of the normal development of the road network, which deals with the construction of major road projects either to gravel or bitumen standards. Table 3.1 compares the classified road network for the whole country and within Lake Victoria basin, while Table 3.2 shows the various classes of roads within the Lake Basin by surface type as at June 1979.

Table 3.4 presents the various road projects in Lake Victoria Basin region planned for implementation during the current development plan period of 1979-83, while Table 3.5 presents the roads that could be constructed if funds could allow so as to improve further the road network in the lake region. Tables 3.6 (i) - 3.6 (ix) presents a full list of rural access roads in nine districts of the Lake Victoria Basin which have been evaluated and are due for construction.

SUMMARY OF THE CLASSIFIED ROAD SYSTEM NATIONWIDE VS. IN THE LAKE VICTORIA BASIN

3.1 1979/83 ROAD DEVELOPMENT PLANS AND PROGRAMMES WITHIN THE LAKE VICTORIA BASIN

Classification	Existing Situation as in June, 1979		
	Whole Country (KM)	Lake Basin	
		KM	Overall %
International trunk (A)	3523.8	412.4	12
National trunk (B)	2704.2	344.8	13
Primary (C)	7490.3	1799.8	24
Secondary (D)	9992.4	2455.1	25
Minor (E)	24583.2	4498.8	18
Total Classified Roads	48294.2	9507.8	20
Special Purpose	2943.7	1557.8	53
Total Classified and Special Purpose Roads	51237.9	11065.7	22

Table 3.2. CLASS AND SURFACE TYPE OF ROADS IN LAKE VICTORIA BASIN

Classification	Bitumen (km)	Gravely Earth (km)	Total (km)	% Bitumen	% Gravely Earth
International trunk (A)	412.4		412.4	100	0
National trunk (B) (B)	267.8	77.0	[illegible]	78	22
Primary (C)	420.8	1399.0	1799.8	23	77
Secondary (D)	61.9	2393.2	2455.1	3	97
Minor (E)		4495.8	4495.8	0	100
Special Purpose	19.9	1537.9	1557.8	1	99
Total	1182.8	9882.9	11065.7	11	89

Table 3.3 presents a summary of the various programmes for the construction and improvement of various classes (categories) or roads during the Fourth National Development Plan period of 1979 - 83 within the nine districts covered by Lake Victoria Basin.

Table 3.3: LAKE VICTORIA BASIN DISTRICTS STATUS OF ROAD DEVELOPMENT PLANS AND PROGRAMME (1979 - 83)

Lake Victoria Basin	[illegible] and Primary Roads Programme			GBC Programme for Secondary and Minor Roads		Rar Programme for Non-Classified Roads		
	Strengthning	Uplifting to Bitumen	Uplifting to Gravel	Aid Financed	Other Donors	Planned (1976-85)	Evaluated As of March 1979	Completed as of March 1979
S. Nyanza	-	73 km (N)	-	220 km	-	600	136 km	136 km
Siaya	22 km (N)	45 km (O)	-	138 km	-		66 "	- km
Kisumu	123 km (N)	40 km (O) 26 km (N)	8 km (N)	72 km	-	"	141 "	22 "
Kisii	46.0 km (N)	27 km (O)	-	127 km	-	"	135.5"	28 "
Bungoms	81 km (N) 45 km (O)	38 km (N)	-	170 km	-	"	92 "	21 "
Kakamega	-	37 km (N)	-	194 km	-	"	58 "	5"
Busia	-	33 km (N)	29 km (N)	73 km	-	"	142 "	6 "
Kericho	75 km (N)	53 km (N)	65 km (N)	-	1/	"	82 "	5 "
Nandi	-	32 km (N)	-	-	1/	"	154 "	- "
Total	392 Km	404 Km	102 Km	994 Km	-	5400	916 "	223 "

Notes:

(N) - New Project

(O) - Ongoing Project

1/ - Negotiations are underway to have the GBC Programme
- Financed by K.F.W. of West Germany

2/ - This is a secondary road (D255) which could come under the GBC Programme.

Table 3.4: ROADS DEVELOPMENT PROGRAMME 1979-83
(Lake Basin Area)

District	Trunk (A&B)	Primary & Secondary Roads (C&D)
1. Bungoma	Broderick falls-Kiminini (45) Turbo-Webuye-Malaba-(81)	Bungoma-Kimilili (38)
2. Busia	-	Luambwa - Bumala (33) Busia Malaba (29)
3. Kakamega	-	Mumias - Kakamega (37)
4. Siaya	Kisumu - Yala (22)	Siaya- (25) Kisian-Bondo (20)
5. Kisumu	Ahero - Kisumu (24) Ahero - Kisii (35) Kisumu - Kiboswa (11) Awasi - Ahero (15) Kisumu - Yala (20) Senetwet - Awasi (18)	Awasi-Chemilil (9) Kisian - Bondo (31) Agoro - Kendu Bay (26)
6. Homa Bay	Ahero - Kisii (34)	Rodi Kopany - Karungu (28) Agoro-Kendu Bay (15) Rongo - Homa Bay (30)
7. Kisii	Ahero - Kisii (12)	Kisii - Kilgoris (27)
8. Nandi		AiNabkoi - Kapsabet - (32)
9. Kericho	Mau Summit - Kericho (49) Kericho - Senetwet (26) Amala - Sotik (53) Total (445)	Sondu - Kapsoit (20) Londiani - Fort Ternan (53) Total (453)

Note: In brackets are the lengths in kilometres of the section(s) in the district(s).

Table 3.5: ROAD IN LAKE BASIN TO BE IMPROVED SUBJECT TO AVAILABILITY OF FUNDS.

District	Trunk Road (A&B)	Primary & Secondary (C&D)
Bungoma		Chwele-Malakisi-Mungatsi (54)
Busia		Kyonzo - Bumala (32) Mbwekas - Mungatsi - Mutungu (44)
Kakamega		Kakamega - Bungoma (44) Chavakali - Yala (25)
Siaya		Bondo - Usenge (28) Rangala - Siaya - Ndigwa (79) Akala - Luanda (21)
Kisumu		Darajambili - Kiboswa (11)
S. Nyanza		Kendu - Homa Bay - Mbita (82) Oyugis - Kendu Bay (22)
Kisii	Kisii-Sotik(54 1/	
Nandi		Senetwet-Nandi Hills (46) Turbo - Kapsabet (53)
Kericho	-	-

Note: In brackets are the lengths of the section(s) in the district(s).

1/ Already being strenthened.

Table 3.6.1: KISII DISTRICT
(RARP)

Road Description	Length	Division	Location
Nyamatutu up North	3.5	Dosongo	Domariba
Riara-Kemejii	4	id	Botitaa
Nyamiobo-Gesongo Market	8	id	Bomariba
Ingeli-Itobo	3.5	id	Bokeire
Gunga - Gasero	4.5	id	Bokeire
Motonto-Betoro-Itiero	10	id	Bomorenda
Tabaka-Miororí-Gasero	7.5	id	Kanyimbo
Miororí-Nyachenge	2.5	Dosongo	Bokeire
Kagambo-Nyatika	5	id	Bosinange
Riosiri-Ikoba Market	6	id	Bogetenga
Ikoba Market-Marongo	4	id	Bogetenga
Nyamarambe Coffee Factory Marango	3.5	id	Bogetenga
Nyamarambe Market-Marango	6.5	id	Bogetenga
Nyangweta-Marango	8	id	Boikanga
Nyangweta-Nyamkembene	10.5	id	Boikanga
Nyamesege-Nyangweta	10	id	Boikanga
Nyangweta-Nyabera	5.5	id	Nyataaro
Nyabera-Marigwa	6.5	id	Nyataaro
Naroo-Muma	6.5	id	Nyataaro
Muma-Ndongo-Nyamaiya	8	id	Botabori
Muma-Nyamondo	2	id	Botabori
	135.5 mm		

Table 3.6.3: SIAYA DISTRICT

(RARP)

Road Description	Approx. Length	Division	Location
Malele Scho. - Agulu-Nyadhi Rangala bridge-Segere	14	Boro	C/Alego
Simenya-Togo-Hono-Ndere	12	Boro/ Ukwala	C/Alego S/Ugenya
Nyangoma-Tingwangi-Uganda-Malunga-Bar Olengo Road	17	Boro	E/Alego
Nyangera-Usire-Liloma	10	Bondo	N/Sakwa
Ajogo-Lwala-Wagwa	8	Bondo	N/Sakwa
Nyambenge-Saradidi	5	Yala/ Bondo	S/Gem N/Sakwa
Total Length	66		

Table 3.6.8. NANDI DISTRICT
(RARP)

Road Description	Length	Division	Location
Makong River-Kaboi	4	Aldai	Kaptumo
Kaboi-Savani	6	"	"
Kipchawat-Mosombor	3	"	"
Kaptumo-Chemase	5	"	"
Kapsaos-Chemase	4	"	"
Ndurio-Chemase	11	"	"
Chepkongony-Ndurio	5	"	"
Makong River-Kapsabet	6	Mosop North	Chemundu
Kapsasur-Samoo	4	"	"
Chepsonoi-Kipsugur	6	Aldai	Kapkangani
Musasa-Chepkumia	8.5	"	Kemeloi
Kamurguywa-Kobujai	6	"	South Nandi Firest
Kaminei-Kibwareng	9	Aldai/Mosop North	Chemundu
Serem-Kaptumek	10.5	Aldai	Kemeloi
Kesengai-3onjoge	8	"	"
Kimaren-Miwani	6	"	"
Chebarrar-Kipsigak	4	Tinderest	Kilibwoni
Kapkibimbir-Cheptarit	10	"	Kilibwoni
Ndubeneti-Mosoriot	5	"	Kositai
Ndubeneti-Mutwot	9	"	"
Kaptildil-Sironoi	11	Mosop North	Chemundu Kosirai
Kaptel-Kapsisiywa	3	Mosop North	Chemundu
Kaptuto-Chepyagoris	10.5	"	Sangalo
Total Length	154.5		

Table 3.6.6. BUNGOMA DISTRICT
(RARP)

Road Description	Length	Division	Location
Machakha-Ndakalu C42	6	South Malakisi	Northe Changara
Nama Wanga-Lwa Khaba	3	North Malakisi	South Wamono
Wamono (D277)-Wasio School-Chepkube Coffee Factory	5.5	North Malakisi	North Wamono
Chepkube (E377) - Chebweki-Chesiro-Cheptais (E277)	9.5	North Malakisi	North West Sasuri
Mulatiwa (E277) -Kapkirongo	9	North Malakisi	East Sasuri
Kutere (D275)-Chelebei Market-Lwanda Market-Changeywa Market	11	North Malakisi	North Namwala
D275-Kopsiro-Chepyku-Kipsikirok-Chepton-D275	15	Mt. Elgon Forest/ South Elgon	Mt. Elgon Forest Namorio
Kapkateny (E315)-Cheptonon	4	South Elgon	Kapkaton
Kimilili (42)-Kamution'g-Kimobo (D275)	7.5	South Elgon Kimilili	Kibengei Namorio Kapsakwony
Chesamisi (D285)-Kamusinde-Kamasielo (E317)	9	Kimilili	Kamakuywe Sokhendu
Chesenende-Kapchebou Market (E318)	2	South Elgon	Kaptama
Chesito (E318)-Kamakoiwa River	3	South Elgon	Kaptama
Kaptalelia Junction (D275)-Kongit Kapsakwony Road (D275)	7.5	South Elgon	Chemoge
Total Length	12		

Table 3.6.2: KISUMU DISTRICT
(RARP)

Road Description	Length	Division	Location
Ogado School-Kiboswa	6	Maseno	Kisumu/East
Magada River-Ojola	4	Maseno/	Kisumu/West
Chief's Camp		Winam	Kisumu-Municipality
Obambo School-Nyaridi	10	Maseno/	East Seme
School-Kaloka		Winam	
Mitanga School-Kitmikaye	3	Maseno	East Seme
Miranga School-Kondit	9	Maseno	East Seme
Kombewa-Got Odong	3	Maseno	East Seme
Lela-Magwar	5	Maseno	East Seme Kisumu
Awach-Nyalunya School	7	Maseno	West Seme
Ngere-Reru	3	Maseno	West Seme
Ngere-Manuanda-Mayieka	5	Maseno	West Seme
Angoga-Bodi	6	Maseno	West Seme
Sigoti-Sangla-Holo	4	Nyakach	S. Nyakach
Sondu-Agai-Dirubi-Miriu Sch. Mamboleo	15	"	S. Nyakach
Bala-Sangoroti-Kandaria	5	"	W. Nyakach
Bodi-Sigoti-Nyabondo	10	"	S. Nyakach
Ahero-Kaluore-Ambaka	5	Nyando	S.W. Kano
Otieno Oyoo-Masogo-Ogenya	8	Nyando	W. Kano
Ranyira-Okano Market	5	Nyando	W. Kano
Siando-Nge Inanza	6	Maseno	W. Kisumu
Kombewa-Bodi-Asati Beach	10	Maseno	W. Seme
Keru-Kaomje Hill	6	Maseno	W. Seme
Kondik-Gombe	6	Maseno	E. Seme
Total Length	141		

Table 3.6.5: BUSIA DISTRICT

(RARP)

Road Description	Length	Division	Location
Likoli - Simba	4	Northern	South Teso
Kotur-Kochlia	7.5	"	"
Simba-Apokor	6	"	"
Kwangamor-Kotur	7	"	"
Tangakona-Busibwabo	10	Central	Bukhayo
Bukhalire - Khuluchina	5	"	Marachi
Luchululo-Rembo-Funyula	10	South	Samia
Chanasiri-Angurai	6	Northern	North Teso
Malakisi-Amagoro	14	"	"
Chelelemuka-Amagoro	6	"	"
Katakwa-Aboloi	4	"	"
Ekisoko-Shidelewa	5	"	South Teso
Kwangamor-Akomboit	4	"	"
Malanga-Namisi	9.5	Central	Bukhayo
Bwaliro-Buhuyi	12	"	Marachi
Madibo-Buyofu	8.0	"	Bukhayo
Bogendi-Musoma	7	"	"
Bukhalalire-Matayos	11.5	"	Marachi
Siebuka-Nambengere	7	Southern	Bunyala
Total Length	142		

Table 3.6.7: KAKAMEGA DISTRICT

(RARP)

Road Description	Length	Division	Location
Maturu-Lorale Market	6	North Kabras	
Matere-Chebaiywa	4	"	
Vihiga-Namirimba	6	"	
Namirimba-Sivilie Scho.	6	"	
Butali Market-Shirugu	5	"	
Samisi-Mutsuma-Bukhakunga	6	South Kabras	
Shirugu-Lukume	5	"	
Shikunga-Cheboso-Lubao	6	"	
Ngavira-Duka M jo School	8	"	
Kakoyi-Chemengeli	6	"	
Total Length	58		

- 565 - IDS/OP 34

Table 3.6.4: SOUTH NYANZA DISTRICT
(RARP)

Road Description	Length	Division	Location
Wangapala-Mamboleo	8	Eastern	Kabondo
Ringa-Awach Kokwanyo	8.5	Eastern	East/Kasipul
Mawego-Ongoro Market Awach Kokwanyo	4.4	Eastern	East/Kasipul
Main Kisumu Road-Miruka Market	7.5	Eastern	East/Kasipul
Mikayi-Dudi School Rioma Market	4.5	Eastern	"
Wire-Nyatindo School Uhuru Market	4.5	Eastern	Central/ Kasipul
Nyangicha-Rabour Kotieno	4	Eastern	West Kasipul
Nyangicha-Awach Tende	5	Eastern	West Kasipul
Kaditonge Market-Oriang	12	Eastern	West Kasipul
Nyangweso Market-Ligisa Omiya	6.5	Central	North Nyokal
Ongweyo-Disi School	6	Central	Gem
Obeke Market-Kameju School	5.5	Central	Kamagambo
Kanyimach-Kamagambo School-Ndonyo Market	5.5	Central	Kamagambo
Lala-Ogama	6	Central	Kanyada
Nyabikongori-Komotobo-Kegonga	7	Kihabcha	Nyabassi
Kugitimu-Maeta Market	6	"	"
Sakuri-Kugitimu	7	"	"
Kitungi Market-Matare-Tangai	10	"	Bwiregi
Ntimau-Nyankongo-Ntimaru	9	"	"
Ikerege Market-road No.8	8	"	Bugumbe
Nyambikaye Market-Ikerege	12	"	Bukira
Nyabokansi Market-Masaba	13	"	Bugumbe
Total Length	159.9	"	-

Table. 3.6.9: KERICHO DISTRICT.

(RARP)

Road Description	Length	Division	Location
Chepkemel-Kapsorok	11	Belgut	Soin
Kiptere-Iraa	8	"	Waldai
Cheribo-Koirir	9	"	Soin
C25-Kalyangwet	3	"	Waldai
Kaptoboit-Cheronget	6	"	"
Boriborwet-Kaptebeswet	8	"	"
Teldet-Kiptule	6	"	"
Tegat-Kapsurer	5	"	"
Seretut-Chepkositen	7	"	"
Kabianga-Koiwalelach	12	"	"
Chebirbei -D228	7	"	"
Total Length	82		

4.0 HIGHWAY DEVELOPMENT AND ITS CONTRIBUTION TO ECONOMIC DEVELOPMENT

4.1 Basic Objectives

The basic of any development plan is to improve the economic and social well-being of citizens. Since 90 per cent of Kenya's population lives off the land, the Government has concentrated its strategy on rural development which is aimed at two main objectives, namely increased agricultural production and the alleviation of poverty. In an attempt to reconcile these two objectives, the Government has formulated a policy of promoting agricultural development with emphasis on small scale farming and rural development whose implementation will require a well integrated and efficient road transport system.

The Kenya Government appreciates the importance of transport as an indispensable tool to economic development, especially the road network system, which plays the role of providing transport linkages within and among geographically separated social - economic groupings of the country. These linkages are necessary in order to allow spatial interaction among the various sectors pertaining to any given area and to allow the area in turn to interact with its peripheral environment. The level of economic development is the determinant of the range and degree of input-output interactions, activities and relationships. This will therefore, determine the overall requirements for transport. Thus transport is closely interwoven with economic development and it affords the country in general the capability of moving resources and goods from one place to another in response to the demand and supply laws, which in turn allows for specialisation and generation of surpluses for exchange on the basis of comparative cost advantages.

The widespread road network throughout the country provides a great degree of mobility and supports the industrial and commercial sector of the economy by making it possible for raw materials to reach manufacturing plants and for services and finished goods to be transported to consumption areas. The road network sustains the agricultural sector by providing transportation between areas of production and consumption and it also affords the means for the export of the surplus agricultural produce. A part from supporting the thriving various economic development activities, road transport enhances the efficiency of utilisation of social institution like schools and hospitals. It aids the versatility of the Government's administrative machinery by affording Government officers the possibility

of ease of travel in discharging their duties. It is worthwhile therefore, to appreciate at this juncture that there is no sector of the economy which does not rely for its growth and sustainance on reliable and efficient road transport. Moreover, roads provide a major transport mode serving not only the urban areas but also the rural areas and afford a great flexibility of linkage and connectivity which are not possible with the other modes of transport. Road transport is the most versatile and flexible form of transport with the ability to carry small units of freight or passangers economically between any two points.

Within the rural setting, which could be typified by the areas within the Lake Victoria Basin, roads perform the function of access in connecting the individual property holdings to the urban centres. This enables farm produce to be transported with ease and speed, from the farm - holdings to the market centres, and for the reverse flow of consumable goods and services from urban centres to the rural areas. In this respect, road transport facilitates the attainment of a number of vital rural development objectives as envisaged in the establishment of the Lake Victoria Basin Development Authority.

Inadequate transport facilities are responsible for the continuance of subsistence farming in many areas, which could otherwise be intensively cultivated. It is needless, to emphasise that, to enhance the utilisation of the agriculturally potential land, adequate and appropriate access is a necessary need. Adequacy of access is measured in terms of road density i.e. road km/sq. km of land area within the zone of influence of the road network. The provision of adequate and appropriate access implies, the availability of ready market of farm produce at relatively low transport costs.

To facilitate the exploitation of the economic potential of the Lake Victoria Basin Region, all weather access should be a prerequisite for the provision of the necessary transport for faster and cheaper transportation of the resultant farm produce to both local and external markets. Tables 4.1 gives the present and planned road access characteristics in the Lake Victoria Basin Region. The future position is bound to be improved further by diversifying the activities of the special purpose roads programme in conjunction with the Integrated Agricultural Development Programme. If this will be undertaken the agricultural potential in terms of the growing of such crops as cotton, tea, sugar, rice etc. will be exploited for the benefit of the whole rural population and the country at large.

4.2 Effecting Changes in Agricultural Landuse

A good road network will encourage shifts in agricultural landuse by promoting production diversification in directions which yield more cash income to the farmers and the whole community. It is a well known fact that lack of all-weather access roads induces agriculturally potential areas to engage in monocultural agriculture, dependent on crops which will not be spoiled easily because of poor crop husbandly. Unfortunately, such crops are normally of low value and consequently their income generation to the farmers is relatively small compared to that generated by the production activities such as dairy and horticultural farming which demand fast and reliable mode of transport for their enhancement. Poor and unreliable transport system also inhibits the development of cash-crops economy especially those like tea and dairy industry, which require that given time limits should be adhered to if the raw materials is to reach processing centres.

4.3 Shift From Subsistance Economy to Market Economy

One drawback to farmers arising from lack of all-weather access roads is that areas which have no access to or are isolated during the rainy season from outside markets offer their produce at prices well below the marginal costs, resulting in very low profits if any. This is brought about as a result of low demand levels arising from that farmers produce more or less the same crops if they have no access to outside markets. This further inhibits the agricultural development within such areas because farmers tend to lose incentive to produce more than their consumption requirements.

Inorder to offset, this setback to farmers and hence enhance the agricultural development of the region, provision of an adequate all-weather access is contemplated, and is currently being implemented through the rural access roads programme which is constructing new roads to all-weather gravel standard and the gravelling, bridging roads to all-weather gravel standard.

4.4 Support to Social Services in Performing Their Development Role.

Social services include the entire range of services and amenities that the government aspires to provide to the community within a given area, the most vital of which are better education and of course better health. Transport access assists the improvement of services rendered by such social

Table 4.1: ROAD CHARACTERISTICS IN LAKE VICTORIA BASIN

District	Population ,000	Area Km^2	Population Density Persons/km^2	Total Roads Classified &SPR	Total Roads Plus Rural Access Roads	Road Density KM/KM^2 Total Roads	Road Density KM/M^2 Total Roads Plus RAR
Kericho	479	4890	48	1718.3	2318.3	0.35	0.47
Nandi	209	2745	76	838.0	1438.0	0.31	0.52
Kakamega	783	3520	222	1600.7	2200.7	0.45	0.63
Busia	200	1629	123	545.3	1145.3	0.33	0.70
Bungoma	345	3074	112	949.9	1549.9	0.31	0.50
Kisumu	401	2081	193	1342.5	1942.5	0.65	0.93
Siaya	383	2534	151	1039.7	1639.7	0.41	0.65
S. Nyanza	663	5714	116	1864.2	2464.2	0.33	0.43
Kisii	675	2196	307	1167.1	1767.1	0.53	0.80

institutions by enabling the local people to have access to the institutions, by providing means of getting the supplies and enabling government officers to travel with ease while discharging their duties.

5.0 KENYA'S ROAD DEVELOPMENT PROGRAMMES GEARED TO GOK'S RURAL DEVELOPMENT OBJECTIVES

The Kenya Government having realized the important role all weather road access plays in economic development and in pursuit of its policy of diversification of development activities to the rural areas, initiated three road development programmes which are mainly concerned with the improvement of road network in the agriculturally potential rural areas. These programmes are the Gravelling, Bridging, and Culverting programme concerned with the improvement of secondary and minor roads, the Special Purpose Roads Programme which undertake to provide access to certain specific developmental objectives such as agriculture, tourism etc., and the Rural Access Roads Programme which aspires to provide all-weather access from farms to marketing centres via the existing classified network.

By embarking upon such ambitious road development programmes, the Government hopes to provide support to the implementation of such activities as the Intergrated Agricultural Development Programmes and the Third Agricultural Credit of the Ministry of Agriculture, where roads are required to provide access to schemes producing such cash crops as tea, wheat, sugar, rice and coffee, cotton etc. and to areas with potential for tourism and fisheries and any other specific rural development activities are likely to be increased by employing labour intensive methods while executing the construction of the roads under the various road development programmes with the resultant income being retained in the rural areas.

The Rural Access Roads Programme will undertake to construct nearly 5400 kilometres of access roads within the nine districts i.e. Kisii, Kisumu, South Nyanza, Siaya, Busia, Bungoma, Kakamega, Kericho and Nandi which are considered to be within the jurisdiction of Lake Victoria Basin. These roads plus, of course, the already existing road network will not only support the agricultural programmes already underway in the Lake Victoria Basin, but will also encourage the growth of certain other activities for which there is a latent demand which remains unsatisfied in the absence of reliable transport. Therefore, the resulting improved road network in the country and in particular within the Lake Victoria Basin of Kenya will not

only enhance the development of agricultural activities such as the production of sugar, tea, rice cotton etc. but will also encourage the upshoot of commercial and trading activities and hence enhance the setting up of small-scale industries within the Lake Basin.

Thus, it could be concluded that communications infrastructure, with particular reference to road transport network, does influence and has the ability to shape the economy of a given locality by enhancing and supporting such economic development activities as agriculture, commerce, industry and tourism and of course, offering employment opportunities not only during the construction and maintenance phase, but also within the road transport industry itself.

Needless to stress, this is in line with the Kenya Government's declared policy of diversification and dispersing economic development activities to the rural areas.

6.0 COORDINATION OF DEVELOPMENT ACTIVITIES BETWEEN LAKE VICTORIA BASIN DEVELOPMENT AUTHORITY AND EXISTING GOVERNMENT BODIES

The government envisages that rural development should be enhanced through the dispersion and diversification of economic development programmes. In pursuit of this, the Government has established various statutory development boards amongst which are the National irrigation Board, the Tana River Basin Development Authority etc., and the latest to come into being is the Lake Victoria Basin Development Authority which was enacted in parliament recently.

The Lake Victoria Basin Development Authority was established to coordinate the development activities of the Lake Victoria Region and initiate further development of the region by harnessing such basic natural resources as water and rich available agricultural land. While undertaking its development activities it would perforce that the authority works in collaboration with the relevant Government Ministries in utilising their services so that the available but of course limited funds could be beneficially utilised in implementing the development programmes more economically and efficiently. Proper coordination between the Authority and the Ministry of Works, in particular through the provincial engineers and the Ministry Headquarters whenever need arises will ensure that appropriate road network is provided, for the implementation of the agricultural activities of the

authority. Thus the authority will save an enormous sum of money which otherwise would be utilised in improving transport system to be used for some other purposes for the benefit of the wananchi.

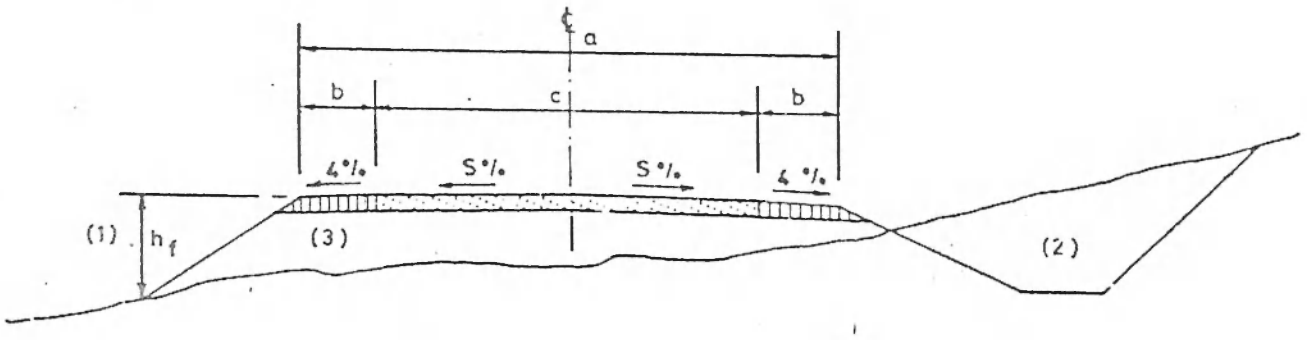
APPENDIX (i)

1978 TRAFFIC FIGURES ON CLASSIFIED ROADS

IN LAKE VICTORIA BASIN (ADT)

District	A	B	C	D	E
Kisii	806	609	130	67	22
S. Nyanza	665		127	25	12
Kisumu	1165	1158	425	74	65
Siaya		685	118	61	16
Bungoma	592		232	35	24
Kakamega	987	1129	625	80	22
Busia	852	1109	87	118	3
Kericho		1201	170	60	21
Nandi			315	71	19
Total	5067	5891	2229	591	204

Legend. A - International Trunk Roads
B - National Trunk Roads
C - Primary Roads
D - Secondary Roads
E - Minor Roads



CROSS-SECTION TYPES II - VIII - SINGLE CARRIAGEWAY

Notes on Figure

(1) The slope of fill: 1:4 where $hf \leq 1m$
1:2 where $1m < hf \leq 3m$
1:1.5 where $hf > 3m$

(2) Type of ditch:

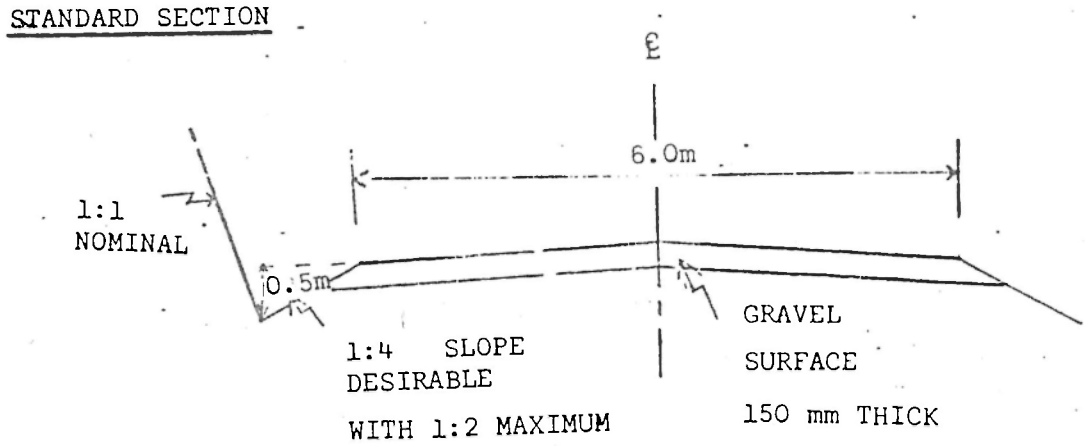
(3) Widen the shoulder by 0.50m where guardrail is required.

STANDARD CROSS-SECTIONS FOR SINGLE CARRIAGEWAY RURAL ROADS

Cross-Section			Dimensions in Metres			Normal Cross-fall in %
Type	Lanes	Surfacing	a	b	c	s
II	2	bitumen	10.00	1.50	7.00	2.5
III	2	bitumen	8.50	1.00	6.50	2.5
IV	2	bitumen	7.00	0.50	6.00	2.5
V	1	bitumen	7.00	1.50	4.00	2.5
VI	1	bitumen	5.00	0.50	4.00	2.5
VII	2	gravel	8.00	-	-	4.0
VIII	1	earth/gravel	6.00	-	-	5.0

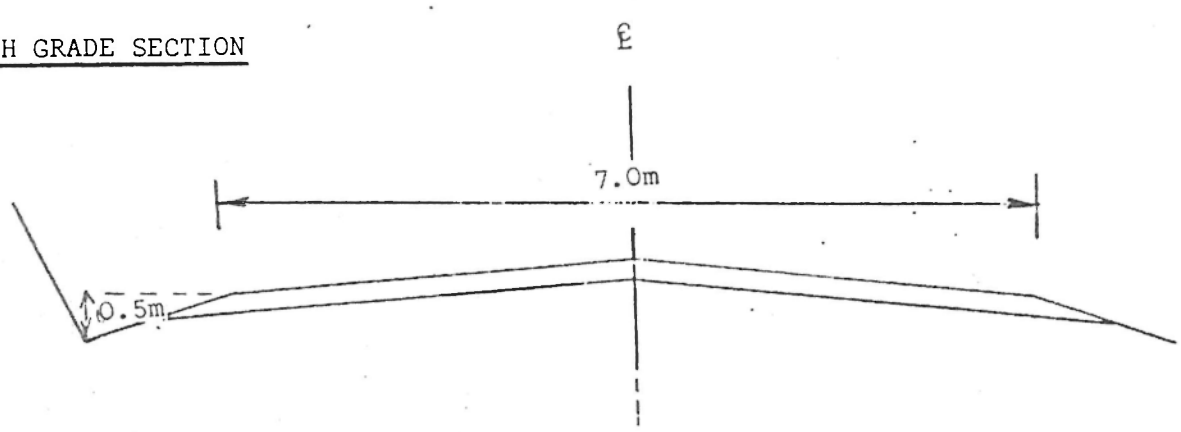
FIGURE 1: TYPICAL CROSS-SECTION FOR RURAL BITUMEN AND GRAVEL ROADS

STANDARD SECTION



(i)

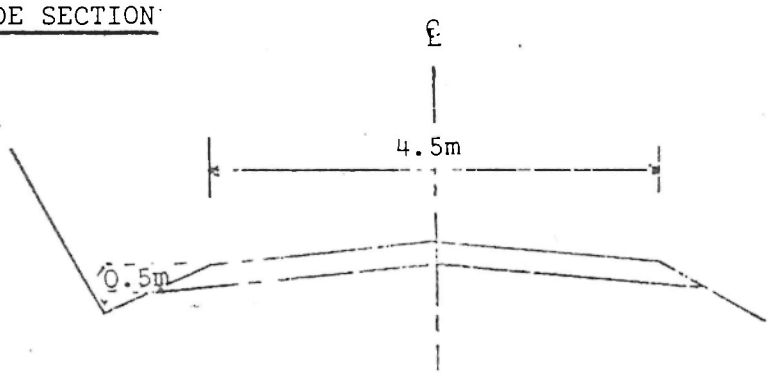
"IGH GRADE SECTION



ALL OTHER DETAILS AS FOR STANDARD SECTION

(ii)

LOW GRADE SECTION

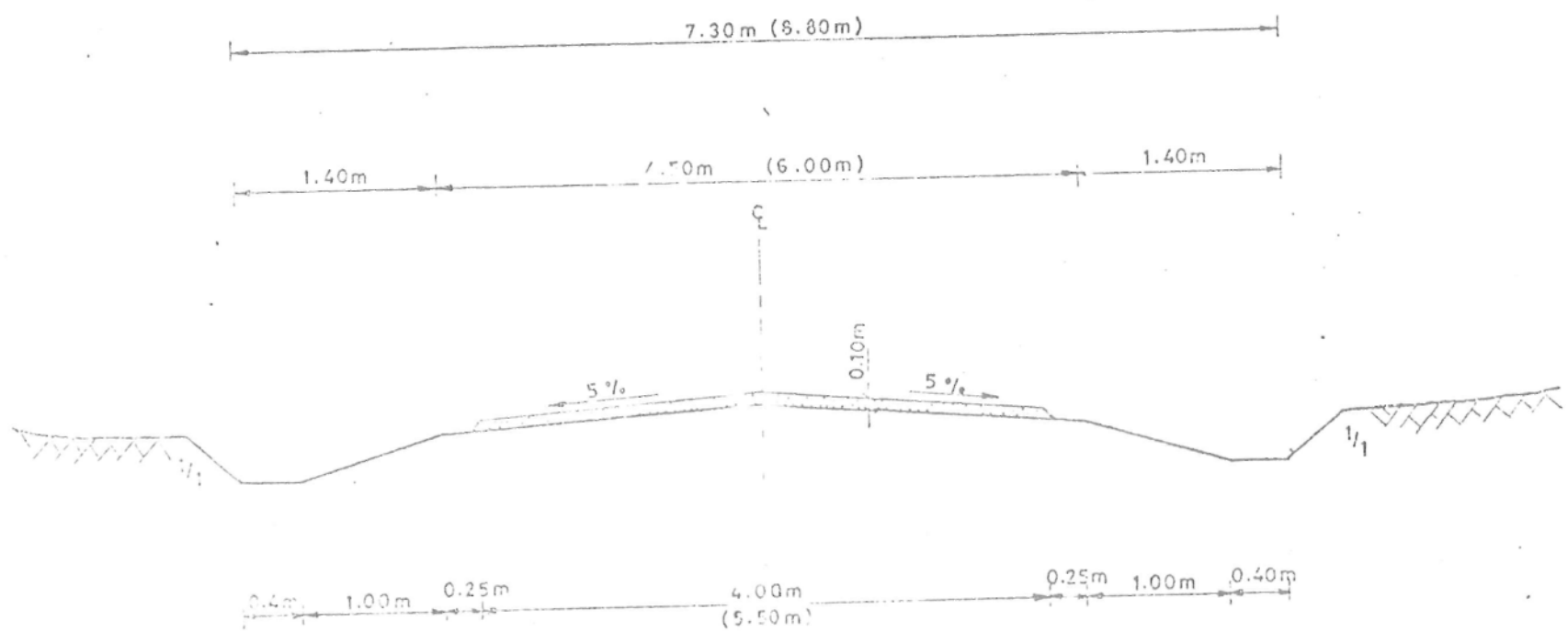


ALL OTHER DETAILS AS FOR STANDARD SECTION

(iii)

NOTES
1. HIGH GRADE AND LOW GRADE SECTIONS TO BE USED ONLY ON THE INSTRUCTIONS OF THE PROJECT ENGINEER.
2. BACK SLOPE OF 1:1 MAY BE VARIED AS CONDITIONS DICTATE.
3. CROSS FALL MAY BE INCREASED ON STEEP GRADIENTS.

FIGURE 2: TYPICAL CROSS-SECTION FOR GDCP ROADS

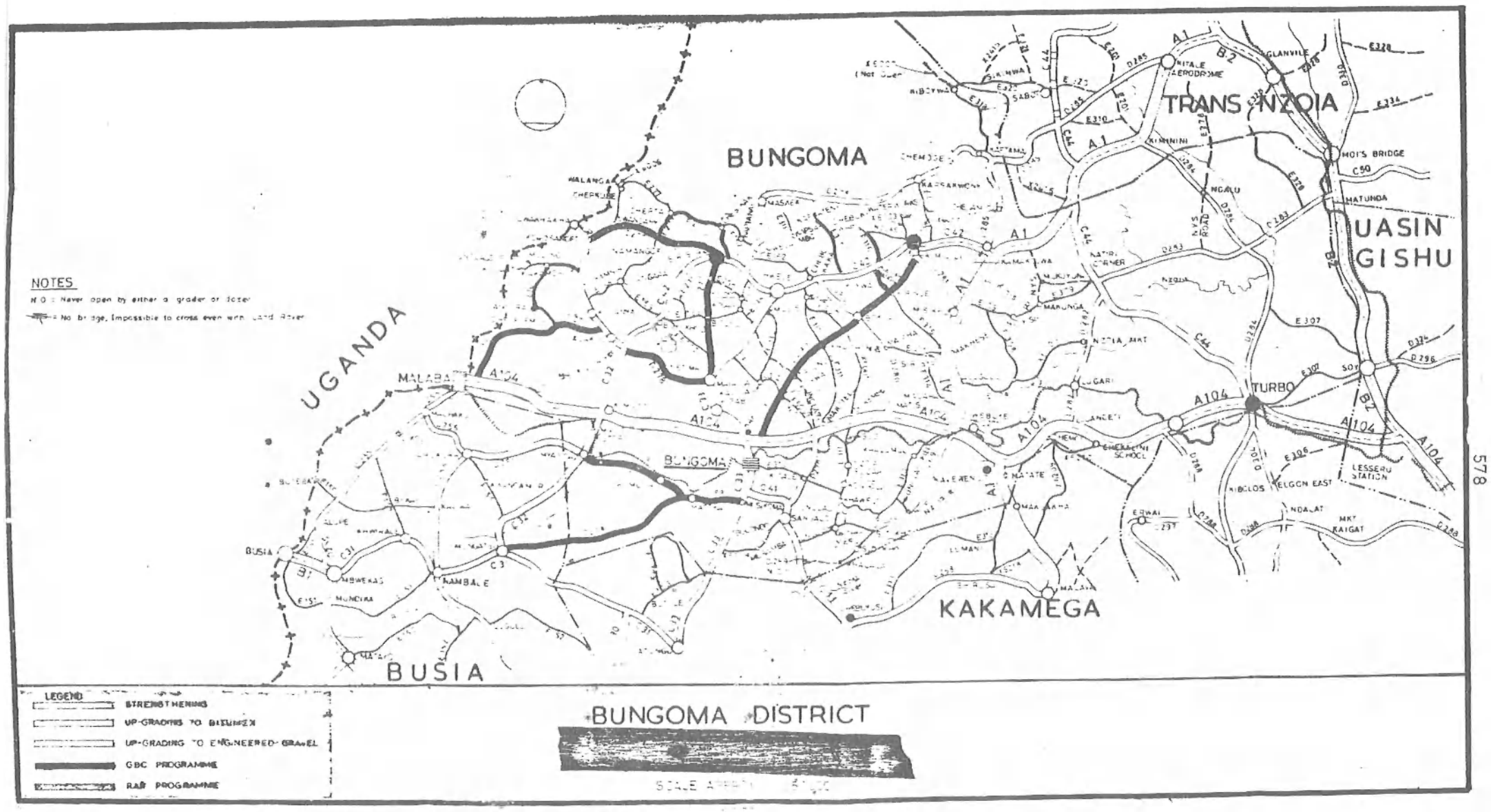


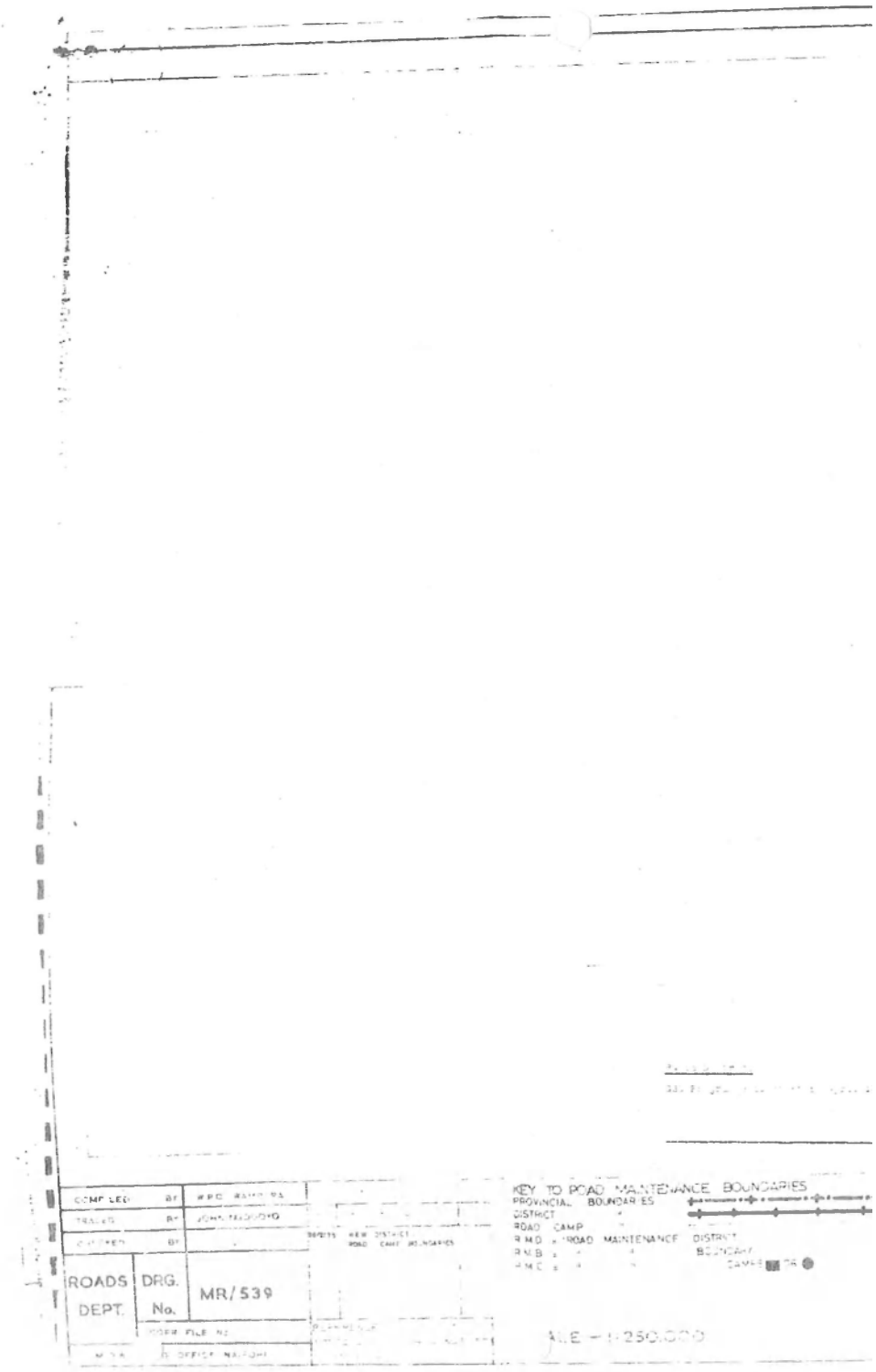
SCALE:- 1:50

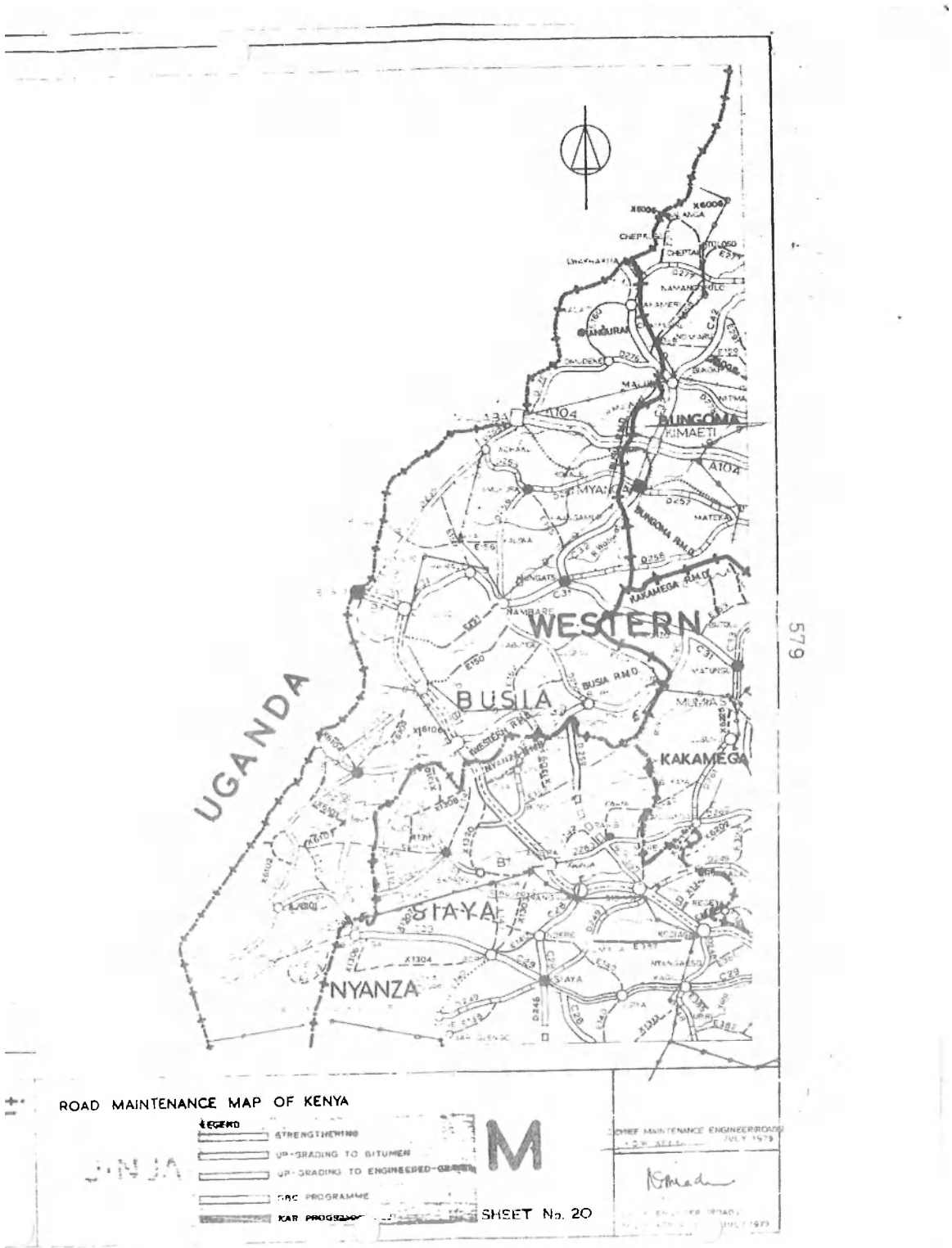
NOTES:

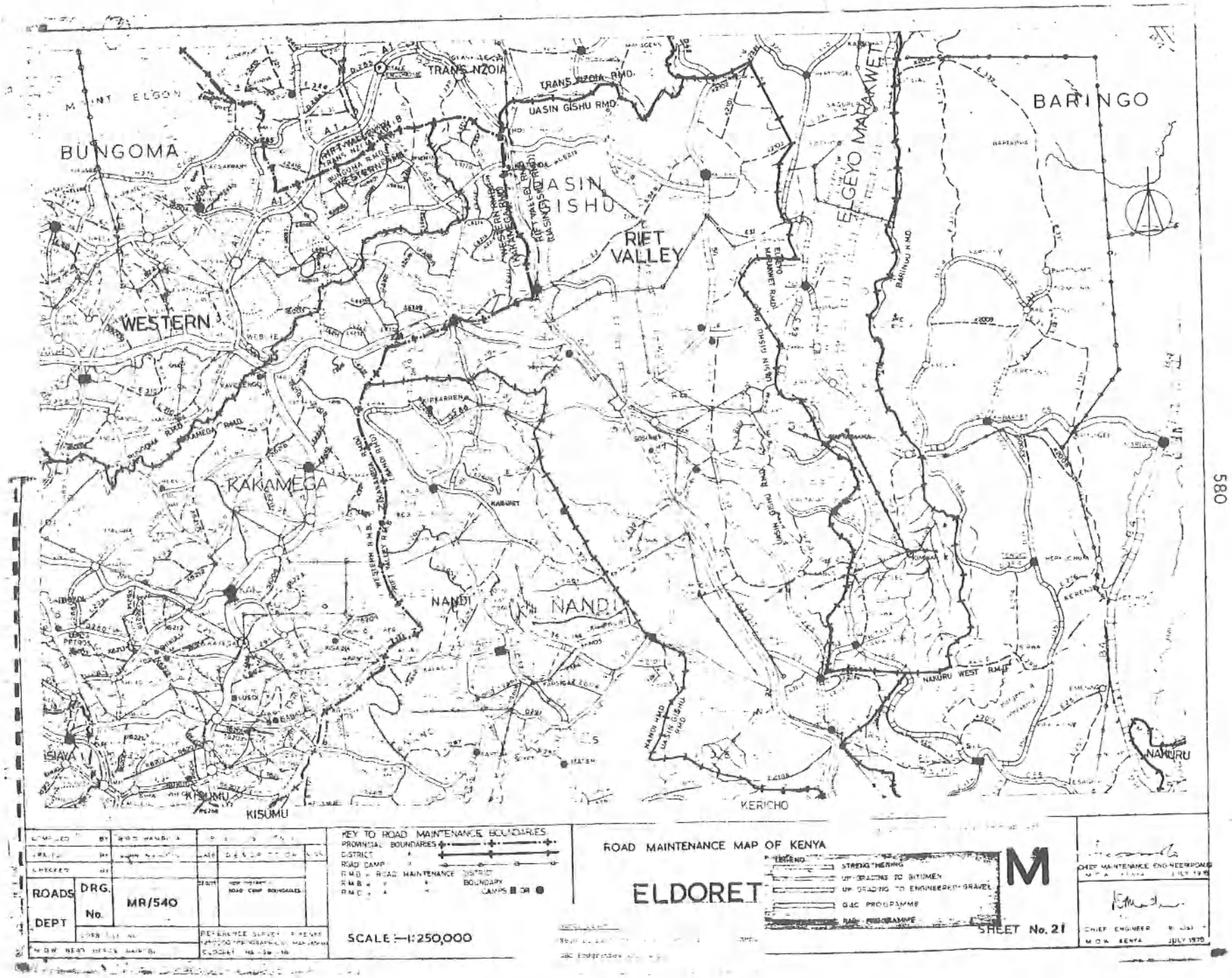
1. Width of earth road formation 4.50m for less than 30 vehicles per day.
   " " " " " 6.00m " more " " " " " .

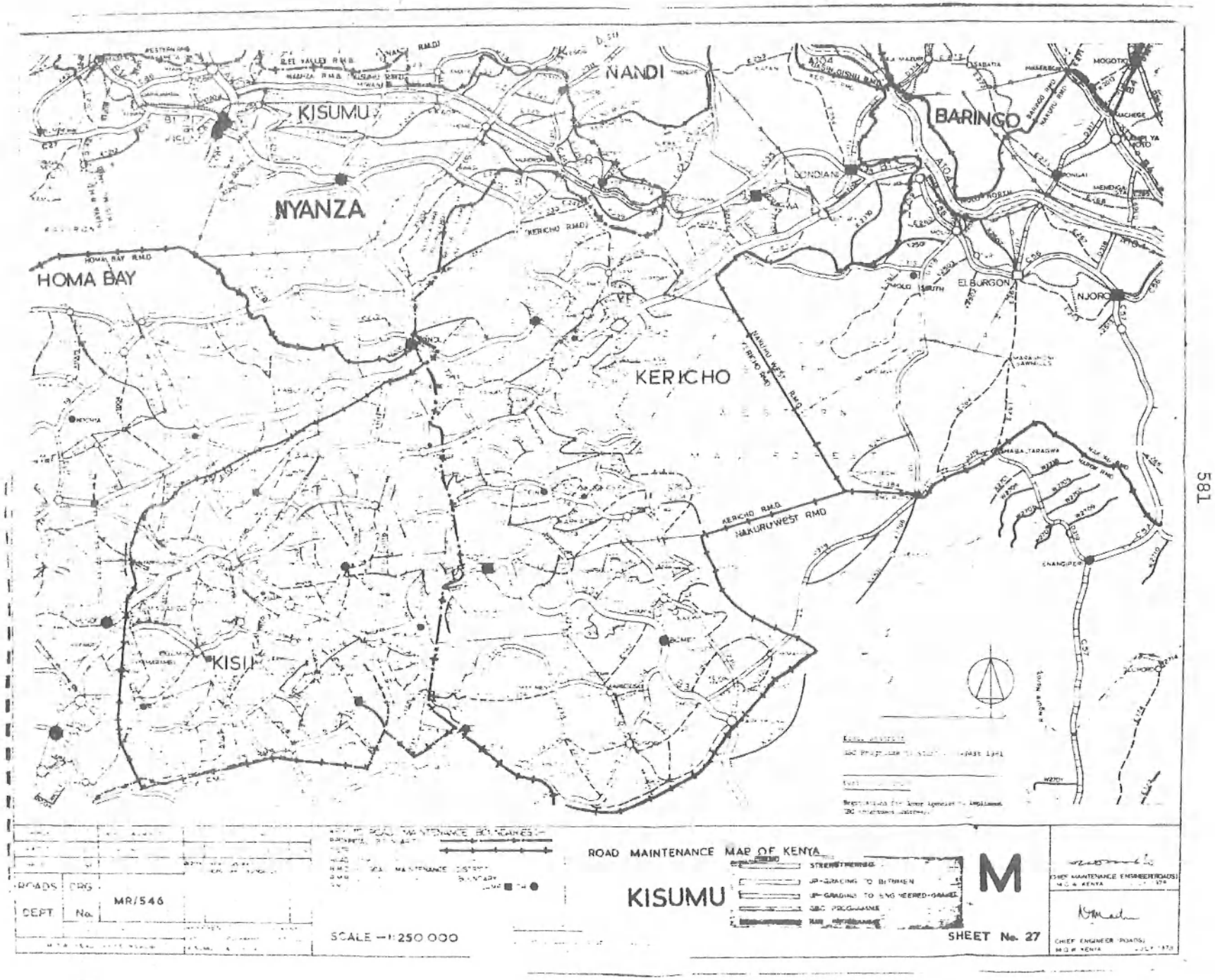
FIGURE 3: TYPICAL CROSS-SECTION FOR RURAL ACCESS ROADS


NOTES
N.O. = Never open by either a grader or lorry
= No bridge, impossible to cross even with Land Rover
UGANDA
BUNGOMA
TRANS NZOIA
UASIN GISHU
KAKAMEGA
BUSIA
MALABA
BUNGOMA
TURBO
A1
A104
B2
C50
C62
C44
C41
C31
C33
D285
D296
E307
LEGEND
STRENGTHENING
UP-GRADING TO BITUMEN
UP-GRADING TO ENGINEERED GRAVEL
GBC PROGRAMME
RAP PROGRAMME
BUNGOMA DISTRICT

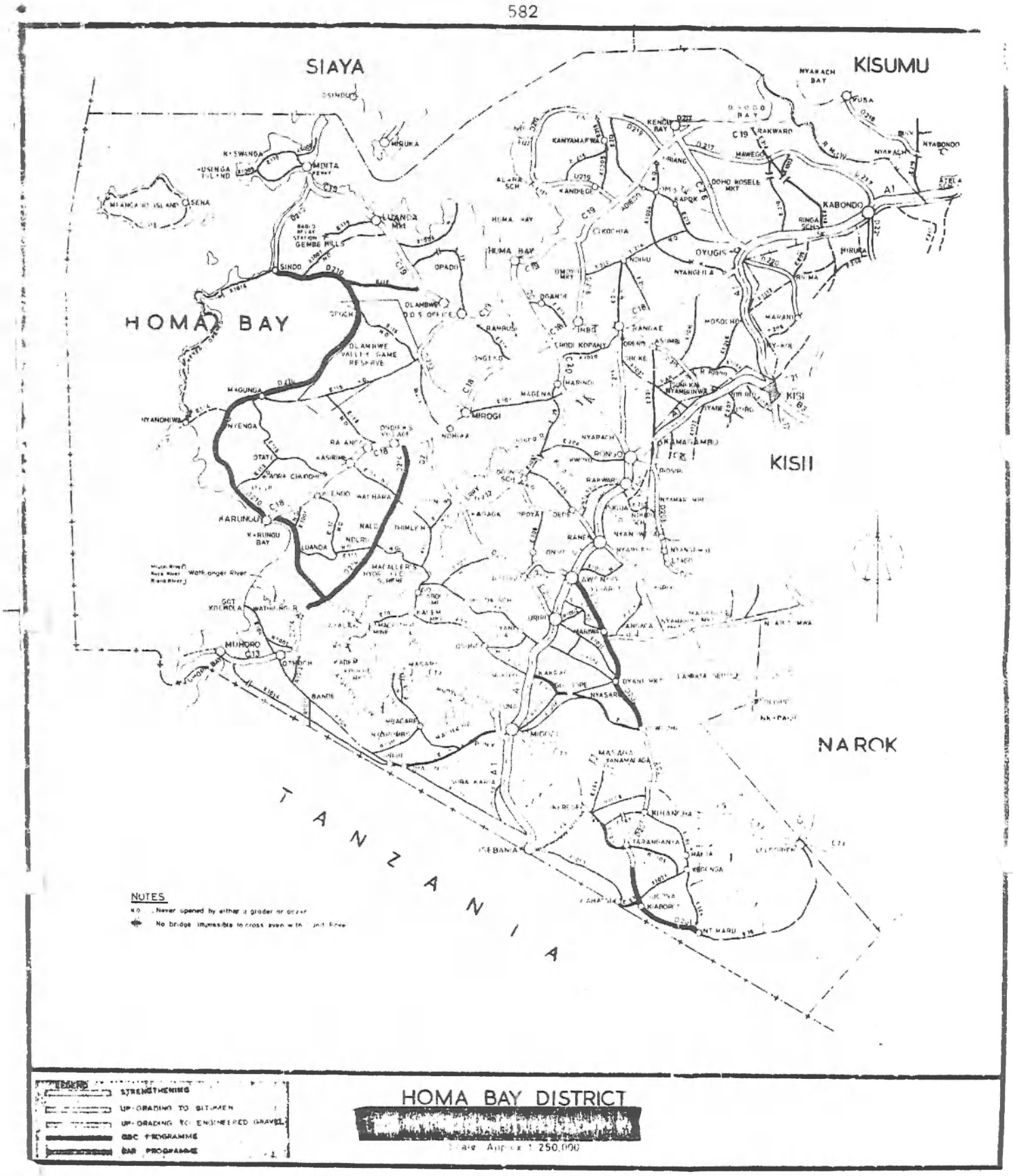

KEY TO ROAD MAINTENANCE BOUNDARIES
PROVINCIAL BOUNDARIES
DISTRICT "
ROAD CAMP "
R.M.D. = ROAD MAINTENANCE DISTRICT
R.M.B. = " " BOUNDARY
R.M.C. = " "
CAMPS
NEW DISTRICT ROAD CAMP BOUNDARIES
COMPILED BY
TRACED BY
CHECKED BY
ROADS DEPT.
DRG. No.
MR/539
USER FILE No.
SCALE 1:250,000

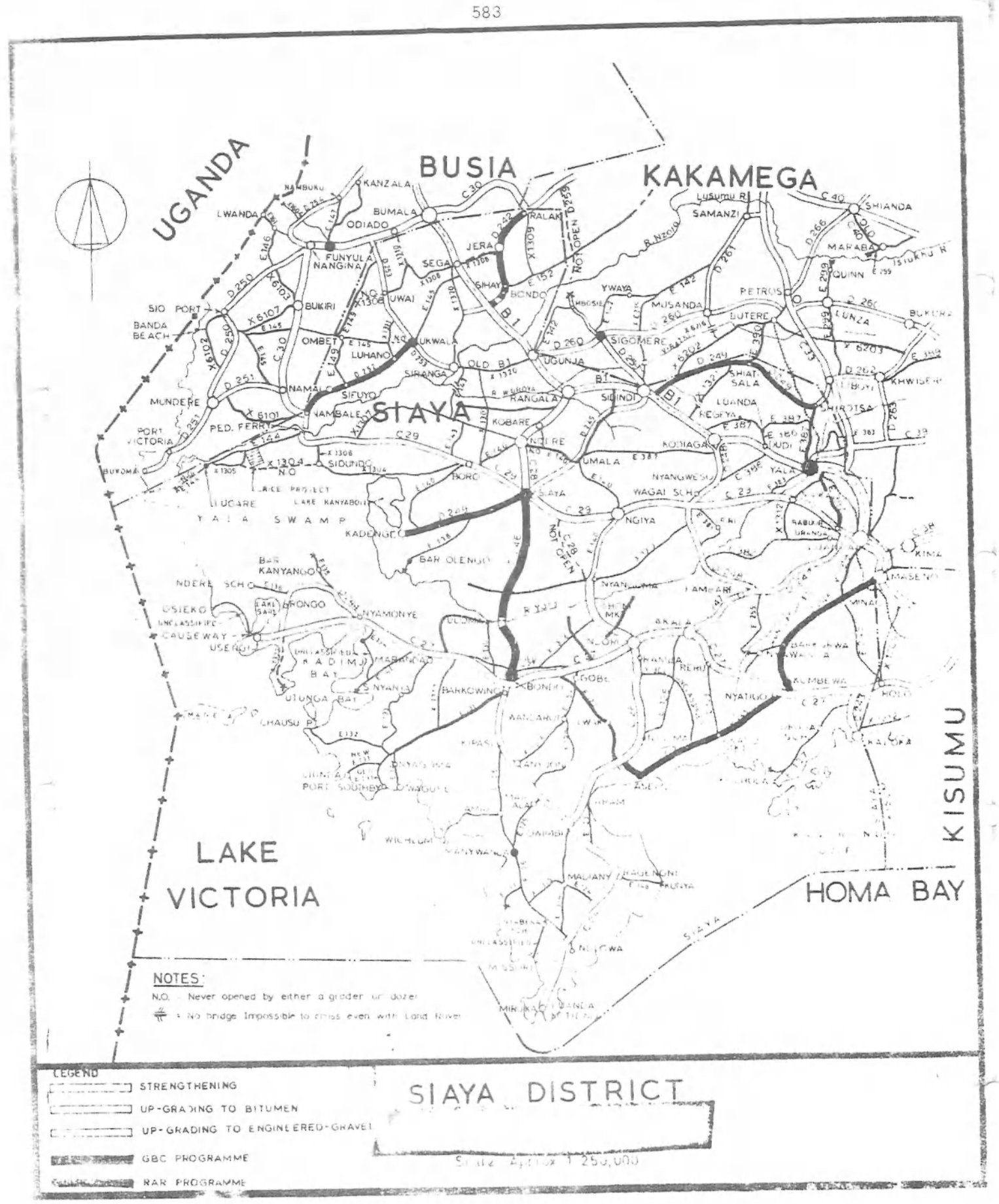

UGANDA
WESTERN
BUSIA
KAKAMEGA
BUNGOMA
KIMAETI
SIAYA
NYANZA
A104
ROAD MAINTENANCE MAP OF KENYA
LEGEND
STRENGTHENING
UP-GRADING TO BITUMEN
UP-GRADING TO ENGINEERED-GRADED
GRC PROGRAMME
KAR PROGRAMME
M
SHEET No. 20
CHIEF MAINTENANCE ENGINEER(ROADS)
JULY 1979


MOUNT ELGON
BUNGOMA
TRANS NZOIA
TRANS NZOIA RMD.
UASIN GISHU RMD.
UASIN GISHU
RIFT VALLEY
ELGEYO MARAKWET
BARINGO
WESTERN
KAKAMEGA
NANDI
NANDI
NAKURU WEST RMD
NAKURU
KISUMU
KISUMU
KERICHO
KEY TO ROAD MAINTENANCE BOUNDARIES
PROVINCIAL BOUNDARIES
DISTRICT
ROAD CAMP
R.M.D. = ROAD MAINTENANCE DISTRICT BOUNDARY
R.M.B. = CAMPS
R.M.C. =
ROADS DEPT
DRG. No.
MR/540
SCALE :—1:250,000
ROAD MAINTENANCE MAP OF KENYA
ELDORET
LEGEND
STRENGTHENING
UP GRADING TO BITUMEN
UP GRADING TO ENGINEERED GRAVEL
G&C PROGRAMME
R&M PROGRAMME
SHEET No. 21
CHIEF MAINTENANCE ENGINEER (ROADS)
M.O.W. KENYA
JULY 1978
CHIEF ENGINEER
M.O.W. KENYA
JULY 1978


KISUMU
NANDI
BARINGO
NYANZA
HOMA BAY
KERICHO
KISII
EL BURGON
NJORO
ROAD MAINTENANCE MAP OF KENYA
KISUMU
M
SHEET No. 27
ROADS
DEPT
No.
MR/546
SCALE — 1:250 000

581


SIAYA
KISUMU
HOMA BAY
KISII
NAROK
TANZANIA
NYANZA GULF
NOTES
STRENGTHENING
UP-GRADING TO BITUMEN
UP-GRADING TO ENGINEERED GRAVEL
GBC PROGRAMME
BAR PROGRAMME
HOMA BAY DISTRICT
Scale Approx 1:250,000


UGANDA
BUSIA
KAKAMEGA
KISUMU
HOMA BAY
LAKE VICTORIA
SIAYA
SIAYA DISTRICT
NOTES:
N.O. = Never opened by either a grader or dozer
= No bridge. Impossible to cross even with Land Rover
LEGEND
STRENGTHENING
UP-GRADING TO BITUMEN
UP-GRADING TO ENGINEERED-GRAVEL
GBC PROGRAMME
RAR PROGRAMME

RECOMMENDATIONS ON GENERAL OBJECTIVES OF THE LAKE VICTORIA DEVELOPMENT AUTHORITY

The Lake Victoria Development Authority, being a permanent and independent public body initiated by the President and established by Parliament, will commence its operations in line with the overall objectives and spirit of the current National Development Plan and, it will concern itself primarily with alleviation of absolute and persistent poverty as well as improving the welfare of the people within the area of its jurisdication through the provision of basic needs.

In effecting these goals the authority should seek to _____

1. Initiate practical strategies and programmes aimed at redistribution of wealth with a view to achieving equity.

2. Plan for and implement balanced human settlement including initiating strategies for arresting the out-migration of quality population within the area of its jurisdiction and effecting orderly redistribution of the population.

3. Promote efficient management of natural resources with due regard to conservation and pollution control in the process of development.

4. Promoting, achieving and maintaining high health standards including proper nutritional standards, identification and eradication of vectorborne and any other controlable diseases and health hazards as well as paying particular attention to general public health.

5. Ensure achievement of full employment of the relevant population through creation of sustainable gainful employment and provision of land to the landless.

6. Encourage, promote and initiate ways and means of affecting popular local participation which should include producer control of industries connected with their produce.

7. Identify and delineate the physical area within its jurisdiction and ensure an integrated regional development therewithin.

1.1 POLICY RECOMMENDATIONS FOR HUMAN-RESOURCES

POPULATION.

The area to be covered by the Lake Basin Authority has a total population of nearly hal the total population of Kenya. The population structure as is the case in the rest of Kenya has a high dependent group.

The population distribution in the Lake Basin area is not uniform with some areas having very high population density and birth rates and other areas being relatively underpopulated either because of adverse climatic conditions or emigration due to other factors.

There has been unfortunate trends of human settlements being dismantled to give way to cash crop development as has occurred for instance in some sugar areas in Nyanza and town developments. In each case the people whose lands are taken in public interest have been given monetary compensation and they end up landless with all the obvious consequences.

Although, the lake basin area has high potential man power resources, emigration of this needed manpower to city and towns or farm is a grave matter for the authority to look into if development aims in the area have to be achieved.

The Lake Basin Development Authority will need therefore to address itself to the following factors affecting population in the area.

1. Population Redistribution

Settlement of the landless and those in densely populated areas may need to be undertaken whenever and wherever possible.

Any reclaimed lands falling vacant for repopulation should as far as possible be settled by the needy people from the Basin Area.

2. There is a need to initiate appropriate measures to maintain a balance of population by attracting and retraining skilled manpowers in the Basin Area to facilitate development of the area.

3. A study should be undertaken to determine the land carrying capacity in the development area in order to guide population and settlement policy.

4. For the foregoing reason it will be important that the Authority should establish a socio-demographic unit under it.

ALTERNATIVE SETTLEMENT

In the event of any land being acquired for development or in public interest, the Authority should adopt a policy of finding equivalent alternative land for such persons displaced. Legal provision for this is already articulated in the Land Acquisition Act Cap 295 of the Laws of Kenya at Section 12(1). The present method of monetary compensation is unfair and likely to create more landlessness in the development area.

HEALTH

Like the rest of Kenya, the Lake Basin area is infested with the common diseases: - Malnutrition, Pneumonia, Diarrhoea and vomitting, Infectious and Communicable diseases, etc. In addition to the common disorders Malaria is endemic in the area. Sleeping Sickness, Bilhazia and poisonous snake bites are added hazards. Of special interest and risk is the hereditary disease SICKLE/CELL Anaemia which affects up to 25-28% of Luo community and 12-15% of Luhyia community. Cancer of the oesophagus has high incidence in this region.

Death rates in the Nyanza and Western Provinces are the highest in the Republic. The contributing factors to this include very few and poor health delivery points with very poor road communications, high population, and the very many hazards rampant in the area. The vulnerable group which are the children and the elderly form a large portion of the population, yet the services for this group are wanting.

The impact of development programmes, if not undertaken in an integrated manner, is likely to magnify the health problems for the people in the area and this in the end may adversely affect development itself. Health hazards are an antithesis to development.

Growth of tourist industry for instance may bring in more sexually transmitted diseases if no facilities for control and early treatment are provided as part of planning. The mining areas may pose radiation harzards amongst other obvious health harzards; irrigation schemes may increase chances of more Malaria and Bilhazia previously common in particular area. Industries may pollute water to the detriment of the people, animals and fishes, to mention only a few of the health problems development may bring with it. Environmental pollution is an obvious health harzard.

Resettlement of displaced persons or settlement persons in reclaimed lands may introduce a lot of public health problems if no prior consideration of the basic health needs of such a community is taken.

The Lake Basin area is capable of growing adequate cash and food crops. There is already an increasing amount of malnutrition and alcoholism affecting people in the area, even the rich areas like Kisii and Mumias Sugar area. As development intensifies, there is a tendency to focus on cash generating projects thereby neglecting the increasing food needs of the population. It must be realized that plenty of money in people's pockets does not necessarily mean they will give priority to food of proper nutritional value before other things. This is obvious in Kisii, Mumias, Mwea irrigation Rice Scheme in Kirinyaga District and in other places.

Hereditary diseases like Sickle Cell Anaemia, causes so much morbidity, mortality and mental stress to families yet it is preventable provide genetic counselling, particularly to school children in intensified.

More research on conditions like cancer of the oesophagus malaria effects of medicinal herbs in the area, psychological problems are all important starting points. This is not to ignore the necessary research on the impact of industrialization and other development projects that may be undertaken from time to time.

There is the long term government plan to increase service delivery points (SDPs) for Maternal Child Health Services. The Authority can augment this by enhencing the commencement and completion of the health projects in the area.

The Authority will need to address itself in broad outline to the following points:

1. The Authority should work to enhance and reinforce regular government efforts to commence and/or complete health delivery points
2. The Authority will need to spearhead establishment of health delivery points in any of the development schemes it may initiate particularly if it involves changing patterns of settlement.
3. The Authority should undertake such research and surveillance measures considered essential for improving quality of life in the Basin area and in each of its development schemes.
4. The Authority should pay unreserved attention to the good and proper nutritional status of the people of the area with special attention to children and the elderly, expectant and lactating mothers.

5. The Authority should recognize the need for family life education, as a factor that would facilitate the development of healthy families.

6. The Authority should undertake all measures possible, working in liaison with the relevant goverment ministries, local authorities, Schools and University, to control and/or reduce Malaria, Bilhazia, Trypanosomiasis and other vectorborne diseases, Sickle Cell Disease and diseases of public health Interest.

EDUCATION

Nyanza and Western Provinces are definitely lagging behind in secondary school numbers and in secondary school entries. In fact, many of the districts are graded as educationally less advanced compared to the rest of the Republic.

Of special significance is the low numbers of girls' schools in the area, a reflection that either very few girls enroll in schools or very few pass the primary education to secondary schools. May be both. Girls are more likely to be used in child labour than boys e.g. baby sitting and Ayah service.

The development of the Lake Basin area will depend in a large measure on the number of people in it who have acquired at least primary school education as this is the beginning point to useful training for simple technologies required for development. Education undirected is liable to be a negative contribution to the desired development of the Basin area. There are already a few foci where relevant technical education can be taught and maximum development of such foci and initiation of others is a desirable aim. The village polytechnics, Institutes of Technologies and Technical schools need the attention they deserve.

Development of the area would benefit from high calibre manpower available locally in the area - Some of the research work require university personnel to augment the staff of the authority. If such personnel are to come from Nairobi and hope to do useful research it is unlikely to be rapid and useful.

Education being a useful arm of development the Authority will need to address itself to the following points:

1. Promote equal male and female education in the area and increase the opportunities

2. Improve the infrastructure in schools for welfare of both students and teachers to make in the basin area attractive to the high calibre teachers, who otherwise throng urban schools.

3. Endeavour to promote technical and functional education relevant to the development of the area, especially in agriculture-oriented technologies.

4. Enhance adult education in liaison with the relevant institutions.

5. Evolve an integrated programme of manpower development to help grassroot development, especially in agro-industries.

6. The Authority should work in close collaboration with the National Council for Science and Technology to establish research institutes focusing on development through agro-forestry, fisheries and industrialization within the basin area to enhance development therein.

7. In consultation with relevant authorities and institutions, the Authority should take initiative to establish institutions of higher learning, at the University level, within the development area. Such an institution should be geared to contribute towards clear understanding and remedy of impediments to development.

INCOME

Income per capita in the Lake Victoria Basin area is one of the lowest in Kenya. There are a few areas, like Kisii, which have relatively high per capita income. However, the basic problem of income maldistribution permeates the entire area. The major factors that contribute to this miserable income level and maldistribution include: lack of gainful employment opportunities; inadequate land use; lack of requisite and timely agricultural inputs; inadequate extension services to small farmers; poor marketing and basic infrastructure; and inadequate support to traders and industrialists.

Small scale farmers in the areas like the sugar cane outgrowers comparatively earn much less than they should because the factory owners and management pay them very little and gain maximally from the sugar cane and by-products. In the cotton sector, the marketing mechanism provided by the Cotton Lint & Seed Marketing Board is grossly inefficient and discouraging to farmers.

Income generation depends on good health of the population. The Lake Basin is infested with a lot of diseases which cause morbidity, and mortality. Moreover, the proportion of dependent population is very large and this imposes extra pressure on the meagre income.

There is a tendency for the income generated in the area being disproportionately chanelled out, due to the control of the enterprises by people resident outside the area and non-availability of the commodities and facilities locally.

It is further important that the potentials of the area, in terms of manpower and other resources has not been fully utilized. Therefore there is room for expanding income-generating projects.

In order to improve the level of income and income distribution in the Basin area the following points should be taken into account

1. The Authority should undertake to promote income generating projects, especially those in agro-industry.
2. The Authority should develop markets locally and assist in identifying foreign markets to regularise income distribution in favour of the area.
3. The Authority should establish basic infrastructure to support agricultural development activities.
4. The Authority should promote producer control and participation in the industries related to the commodities they produce.
5. The Authority should alleviate frustrations to the farmers in all ways possible.
6. The Authority should endeavour to provide forum for popular participation in community welfare matters and enhancing provision of basic needs of the country.

1.2 POLICY RECOMMENDATIONS ON WATER AND MINERAL RESOURCES.

(a) WATER.

The development activity of the Lake Victoria Basin Development Authority is to revolve around the development and conservation of natural resources with special emphasis on water. Attempts at planned utilisation of water resources in the Lake Basin date back to the colonial period. However, there have been pilot schemes focussed mainly on the use of water for irrigation in the Kano Plains.

The establishment of the Authority marks a significant departure from the past trend in that water is to play a key role in developing the "development area" i.e. Nyanza and Western Provinces, while planning is to be done for the whole "catchment area" which extends to parts of the Rift Valley Province. In brief, the crucial implication is that planning for the use and conservations of water is to be done comprehensively for the whole affected region, and not just isolated locations; water is to be utilised in appropriate combinations with other resources. An important qualification worth noting is that water of the basin, particularly the Lake Victoria waters, is an internationally shared resource.

There is established evidence that it has an abundance of both surface and ground water which is currently underutilised and underdeveloped. Furthermore, and this is more important, the water is of "excellent" chemical quality for industrial and agricultural uses, and is suitable for domestic use as well.

Problem Areas-

There are possible problem areas in the planning and use of water resources in the Lake Basin that require close attention at the outset: These are:-

(i) frequent and devastating floods
(ii) irregularity and unreliability of rainfall
(iii) increased salinity as a result of irrigation
(iv) increased pollution due to industrial effluents and municipal discharges
(v) higher levels of sediment production
(vi) changes in water level of Lake Victoria.

Recommendations

A The provision that the scheduled ministries or their agents carry out the implementation task for the Authority requires that the Ministry of Water Development be strengthened as a matter of urgency. It is the youngest ministry and will not have established itself at the local level, and certain relevant departments may not even have been established in the Ministry as yet. In this exercise, the ministry's work as it relates to the Lake Basin should be a major priority area. Appropriate measures should likewise be taken with regard to the National Irrigation Board, which is under the Ministry of Water Development.

B The key to solving current problems of water utilisation in the Lake Basin is the establishment of multipurpose water reservoirs. The proposed reservoirs, would facilitate management of flows to eradicate floods which cause human suffering as well as hampering agricultural development; solve problems associated with water and soil conservation hydropower development, irrigation, rural and urban water supplies. There should be special emphasis on supplying domestic and livestock water in the dry areas.

C The generation of hydroelectric powers should be geared specifically towards rural electrification and the supply of more electric power for urban and industrial centres. This may also enhance dicentralization of industries.

D Pollution prevention should be a priority consideration in the contemplated large scale utilisation of water. In the Lake Basin this is a task in conservation of existing quality as opposed to rehabilitation. The necessary steps which should be taken include:-

(a) The Water Quality and Pollution Control Section of the Ministry of Water Development should have the capabilities of maintaining quality standards of effluents from industries and municipal centres around the Basin area.

(b) It will be economical to locate large water consumer industries in the Lake Basin but the Water Apportionment Board should be empowered to investigate the actual factory processes. It is with this knowledge that possible pollutions by industries can be ascertained and curbed.

(c) There should be codes of practice for industries like sugar, textiles tanneries and others as those established for coffee.

(d) While the Ministry of Water Development should step up provision of extension service to municipalities on waste disposal the latter should provide Water Apportionment Board with returns on their discharges on a regular basis.

(e) The Water Apportionment Board should be empowered to grant or issue permits for all discharges from industries irrespective of the source of water or whether it enters public sewer or water-course. The Water Act and the Public Health Act should be made complementary and harmonized to take account of the complexity

of modern industrial activities.

(f) To maintain river water quality effluents should be controlled so as not to overload the rivers' self-purification capacity. Industries should be required to recycle the water they use. Wherever possible, appropriate tariffs should be established to limit the values for potentially toxic pollutants and such tariffs should be published.

(g) The Ministry of Agriculture, Conservation Unit, should be strengthened to limit sedimentation through soil erosion. The ministry should also pay attention to adverse effects of widespread use of pesticides and fertilisers on soil and water quality. The Authority should have its own specialists that investigate and advise on sediment production and salinity tolerence.

E Land reclaimed around the lake, as a result of proper water management, should be used for settling the local population, especially those who have not permanently migrated due to social - cultural reasons despite frequent floods. The mistakes of earlier schemes such as population displacement should, however, be improved upon.

F It should be a major priority of the Authority to carry out studies to fill the wide gap in hydrological data. The Authority will need to engage immediately, hydrologists and other experts for those purposes.

G It is estimated that there will be enough water for use in the Authority's initial projects from control of floods alone. The use of Lake water should therefore be a long term plan and should be reflected in the national development plans.

H The studies conducted on water resources should establish Kenya's needs vis a vis other riparian countries, both present and future, to ensure proper use of water as an internationally shared resource.

With regard to Lake Victoria, the Authority should liaise with the Ministry of Water Development and Ministry of Foreign Affairs to establish a useful basis for negotiation on a comprehensive regime for utilization of the Lake which we share with two other states.

(b) MINERALS:

1. By their nature the exploitation of mineral require expensive capital investment particularly at exploration and development levels. Foreign private capital has been dominant in the region but most of the mines have been abandoned. These include the gold mines at Macalder, Kibigori, Kakamega and Copper at Kitale.

   Using more efficient technology it would be possible to investigate the feasibility of re-exploitation of these mining but with emphasis on integrated exploration within mining districts. For example, in gold mines there is always a possibility of finding silver. There are good prospects that gold could be exploited at Macalder, Kibigori, Koyo, Kaptumo, Maragoli, Korwenje, Ngiga, Lamac, Kakamega, among other places.

2. The geological formation are favourable to the availability of Iron ore. This needs exploration. Radioactive minerals, tangsten and tin also require further exploration.

3. Among non-metalic minerals the Gusii soap-stone need to be developed and processed so as to produce glass orifices and low voltage insulators. Limestone at Homa is currently used inefficiently. There is possibility of diversifying its use when hydrated to include its use for road stabilisation in combination with the pozzolan from Lumbwa (Kipkelion).

4. Graphite is available at Cherangani Hills, further studies should be to ascertain its economic viability.

5. Homa Hill is a potential site for geo-thermal power source and should be explored in association with the current Rift Valley project. Where the geysers are inadequate for power generation, they can nevertheless, form a good source of recreation as warm swimming pools, integrated with tourist attractions.

6. The geothermal investigations should also consider possibilities of integration with aquaculture, using cooled mildly saline water.

7. There are other mineral resources that can be developed for the building and construction industry such as cement, concrete, bricks, roofing tiles, clayworks, etc. The same can also be used in road building.

8. Apart from industries connected with the minerals discussed above, the region abounds in raw materials justifying establishment of a glass factory, sulphuric acid processing plant, ceramic industry and the use of arseno-pyrite to produce arsenic oxide.

1.3. POLICY RECOMMENDATIONS ON LAND USE

Several types of land use systems are found in the Lake Basin including:

a) rainfed smallholder agriculture.
b) large-scale farming:-
   i) low density settlement schemes.
   ii) mixed farming on farms of 400 hectares or more.
c) Large-scale irrigation schemes.
d) Livestock production under ranching system.

Agricultural production under the smallholder system is predominant. Farm sizes are small ranging from less than 0.5 Ha., in Vihiga Division of Kakamega District to about 3 Ha., in Siaya and South Nyanza Districts. Land shortage is evident and in some areas rural landlessness has already emerged. Given the circumstances, the objective should be to ensure land use intensification inorder to generate income and employment.

A. CROP PRODUCTION

Several cash and food crops are grown under rainfed conditions. However there is a need for further studies with a view to intensification of production and/or introduction of new varieties of profitable crops. Some of the food crops are also cash crops.

1. Food Crops:

Maize, the major staple for the local population is grown for subsistence and commercial purposes. Hybrid maize is grown and outyields the local varieties substantially although it has not been broadly adopted. Its production should be intensified subject to improvement provision of inputs and marketing of the crops.

Other food crops include sorghum, millet, groundnuts, bananas, sweet potatoes and cassava. Despite the popularity of some of these crops there has been considerable neglect by the Ministry of Agriculture. Better varieties should be screened and developed since they are better adapted to the drier areas.

Adequate food crop production should be ensured inorder to provide adequate nutrition for the population. To this end, we emphasize that land use should be properly balanced to ensure that farmers do not shift to cash crops neglecting food crops. Proper storage and pest control measures should be designed to reduce losses caused by rodents, insects and moisture.

2. Cash Crops.

(i) Cotton

Cotton production is always below target despite government hopes to the contrary. The potential for increased production is great. There are however, several problems associated with cotton including;

a) low yields arising from poor cultural practises, (diseases, pests, lack of timely planting, etc). There is probably no crop grown today with more pests than cotton. In the long-run better strains of cotton should be developed while timely and adequate supply of inputs especially chemical sprays should be ensured.

b) Extension services for cotton farmers is woefully inadequate. There is a need for increased number of extension officers with speciality in cotton farming.

c) Improved marketing should be ensured including strengthening cotton cooperatives, proper storage and timely payments for cotton delivered.

Prices paid to farmers are extremely low, relative to the cost of production and vis a vis other competing enterprises. In this regard the deductions by the Cotton Lint and Seed Marketing Board should be kept at a minimum and the Boards operations streamlined to meet the needs of the farmers.

ii) Sugar-Cane

There has been dramatic increase in acreage under sugar cane. To some extent, the sugar idea has been over-sold to the public with the result that there is widespread neglect of food crops. Similarly, the factories have often failed to cope with cane production. It is a fact then that sugar cane output has been a mixed blessing for some farmers.

a) Most smallholders beyond the outgrowers zone have been unable to sell their sugar because of zoning restrictions. Also within the sugar-cane growing zone rationalization is required to ensure optimal delivery of cane to the various factories. Prompt payments for cane supplied should be made and all magendo in connection with reception and weighing of cane eliminated.

b) Families have been uprooted to create room for the nuclear estates. Despite compensation some have been unable to obtain alternative land. Displaced farmers should be resettled elsewhere; compensation should be preferably land for land.

c) Farmer participation, through buying of shares, in the sugar factories should be encouraged. The ultimate goal should be to give the farmers decisive control over the industry.

iii) Tea

Tea is being produced successfully under the aegis of the Kenya Tea Development Authority which provides the necessary infrastructure. However, there is adequate evidence that production has already outstripped existing factory capacities and therefore adequate capacity should be ensured. There is potential for increased production in the area.

iv) Pyrethrum.

Kisii district is the leading pyrethrum producing area in the country. The aim should be to increase yields per hectare and at the same time raise pyrethrum content. Better cultural practises are required. However labour is a major constraint regarding further expansion of area under pyrethrum.

There should be intensified training of technical staff that can promote increased productivity of the farms.

v) Coffee.

Coffee is also grown in the Lake Basin. The goal should be to intensify production and raise yields through better cultural practices. Rehabilitation of coffee gardens under the Coffee Improvement Programme should ensure favourable response by the farmers. Problems of disease control, marketing improvement for coffee and supply of inputs have to be overcome.

vi) Tobacco.

Tobacco is grown largely in South Nyanza District. The objective is to make Kenya self-sufficient in tobacco. Attractive prices are provided by BAT Kenya Ltd. However, there is one problem associated with the industry namely inadequate trees for flue-curing. There is a need for increased aforestation for this purpose.

vii) Oil-Seeds.

Groundnuts, sim sim and sunflower are available in the area. Improved cultural practices and marketing could help the expansion in the output of these crops.

Soya production should be investigated as a basis of improved nutrition of the area. Soya oil, milk and cake as well as livestock feed industry could be developed. The soil in Migori Division of South Nyanza is said to be particularly suitable for Soya beans.

viii) Horticultural Crops.

There is a large potential for fruit production to include citrus fruits, various vegetables as well as flowers, green vegetables which are generally in the area, could be grown by farmers for food and cash. Crops like bananas, passion fruit, pineapples and Irish potatoes grown in the basin are and should be encouraged.

B. LIVESTOCK

a) Cattle: The Basin Area is a net importer of milk even though it is an area of high potential for dairy cattle. There is also high potential for beef cattle in the area. Therefore production for both should be intensified. Improved qualify cattle should

be introduced for these purposes. Meanwhile, measures to control ticks, tsetse flies and other sources of cattle diseases should be intensified.

b) Sheep and goats should be reared for their milk and meat. Improved breeds should be introduced to enhance the yields.

c) Poultry: An integrated poultry project, including breeding, hatching, egg and broiler production should be initiated. This should include feed manufacture and marketing organization. Soya bean, cassava and sweet potatoes should play an important role in the feed industry with the aim of providing low priced feeds. The cost of feeds in the market today would discourage the industry. Existing poultry projects should be expanded and improved given properly priced feeds and technical advice. Quail production should also be encouraged.

d) There is potential for pig production in the area. Their feed production could be integrated with that of poultry.

e) Bee honey production can be expanded through effective extension services and management. The present pilot projects in the country, such as Sondu (Ayier Gweng) and Maseno should be given effective management and expanded.

C. General Constraints to Production

Greater productivity and better land use will not be achieved unless the following problems are solved.

1. Marketing Defeciencies.

These should be overcome to ensure adequate incentives to the producers.

i) Provision of agricultural inputs such as fertilizers, pesticides and other agricultural chemicals for disease control should be improved. But primary effort should be put into using locally available manures for fertilizers.

ii) Marketing of products.

Strengthening of existing co-operatives and improvement of their performance is necessary. Studies of marketing problems should be done for every crop separately and remedies implemented.

2. Road system

The major urban centres of the area are well connected to the national road system. However, agricultural access are often poor and inadequate making it rather difficult to supply agricultural inputs and to collect output. Construction and improvement of rural access roads should be considered a priority if agricultural productivity is to be encouraged.

3. Supply of credit

Agricultural credit is an important instrument in improving the productivity of the farm especially when used for productive investments that provide reasonable returns. As a general rule financial institutions, in Kenya insist on land titles for collateral. This means that except for Kakamega and Kisii where land registration is complete, credit is not readily available since about 60% of South Nyanza, less than 50% of Siaya and 80% of Kisumu districts are adjudicated. Acceleration of land adjudication programme is required.

Credit is also channeled through co-operatives and hence strengthening of co-operatives as mentioned before will be essential since some of the loans do not need to be secured by a land title. More credit could also be available through the Integrated Agricultural Development Programme and it should be extended to the entire basin area.

Credit for stockists of agricultural inputs is often lacking leading to shortage of agricultural inputs. Credit supply should be geared to meet these needs.

4. Extension.

An effective agricultural extention service is crucial for greater productivity. It is therefore necessary that an adequate number of qualified personnel is maintained to serve the population. Improvement of infrastructure would enable better supervision of extension workers and boost morale. There is high cost of individual farmer contact approach and it has a tendency to concentrate on the better farmers. This should be encouraged in favour of group methods.

5. Conservation

Land utilization should ensure that agricultural and range management practises do not lead to indiscriminate destruction of forest areas, soil erosion and concomitant siltation of rivers and lakes. The provisions of the Agriculture Act Cap. 138 of the Laws of Kenya should be enforced, and forests gazetted to protect water catchments.

Land use questions should be integrated in to a general environmental protection act and provisions made for assessment of impact of plants for municipal and industrial land use to the extent that those uses would conflict with agriculture.

6. Research:

There is a need for co-ordinated research in resource use, in improved agricultural practises, improved performance of projects and on monitoring the impact of various activities. Improved data base is required for better planning. Research in agricultural mechanization is considered necessary and especially the development of ox-plough implements which are considered more appropriate than tractors given the small farm sizes given the predominance of small farms in the area.

D. Irrigation and Land Reclamation.

There is an apparent preference to expand irrigation farming in the Lake Basin. Irrigation farming is already underway at Ahero, West Kano and Bunyala. The concentration on monoculture as in the case of rice and sugar-cane tends to undermine the subsistence base of the people and there is evidence that malnutrition is emerging as an important problem. The question of diversification of production to ensure adequate food crops need to be addressed. Horticultural crops could be grown near irrigation canals.

Land reclamation through drainage of swamps should be pursued to provide settlement land for the landless and to expand area under irrigation. Given the high cost of implementation and incomplete understanding of environmental implications drainage of swamps should not be considered a priority over construction of multi-purpose reservoirs for irrigation, flood control and hydro-electricity generation.

POLICY RECOMMENDATIONS FOR "OTHER NATURAL RESOURCES"

The focus is on fisheries, forestry and game. From the nature of these resources, it is apparent that the need for infrastructure, conservation and management issues are particularly acute. Further, there is a need for appropriate technology and general capital investment to facilitate commercial operation of ventures using these resources. The following are problems, potential advantages, and possible policy strategy for the area.

A. Fisheries

1. Fish production from the Kenya waters of Lake Victoria currently stands at about 20,000 tonnes per annum. It is, however, estimated that the "optimum sustainable yield" from this area of the lake would be higher, about 30,000 tonnes, per year. There is, consequently, still considerable scope for increasing fish production from the highly productive Kenya waters.

2. Inadequacy of good road network is currently a major constraint against the marketing of fish within and outside the region. This causes gross and persistent loss to fishermen and fishmongers. There is therefore great need to develop all weather access roads from the landing beaches to the outside markets.

3. Fish is a highly perishable good and there is urgent need for the establishment of proper storage (deep-freeze) facilities and other preservative methods which can make it possible for good quality fish to be transported to markets within and outside the region. There is further need to investigate the possibility of establishing fish processing industries.

4. Fish is an important source of animal protein and can be promoted to compete with other sources of animal protein that are becoming increasingly expensive, through increased harvesting, distribution, and marketing. To this end

a) fishermen should be helped to adopt improved and appropriate fishing equipment which should be able to conserve the younglings,

b) Longline and gillnets of wide measure should be preferred although studies to determine the exact and desirable sizes for on-and off - shore zones should be undertaken and implemented.

c) Trawling in Lake Victoria has been a controversial subject.

It is argued the trawling would off-set the optimum balance sustainable yield of the stocks and possibly deprive the artisanal fishermen and local communities of their food resources. Serious studies should be undertaken to determine the advisability of any nature of trawling at various depths and ecological zones. Such studies should precede any trawling exercises.

d) Ecological zones in the Lake Victoria should be established for purposes of regulation of fishing by seasons. This would improve the conservation standards.

e) The Authority and the Fisheries Department should establish and enforce regulations regarding river fishing, control of mass fishing of anadromous and mud-dwelling fishes during floods and general migration upstream. Appropriate rules should be adopted to prevent overfishing of specific species such as the Barbus (fwani-odhadho) and Labeo Victorianus (ningu).

f) strengthen the efficiency and encourage popular participation in Fishermen Co-operatives with adequate credit and saving facilities. There should be a specialist in fisheries cooperatives to help with institutional organization and marketing.

g) Wind and current patterns should be carefully studied, taking particular advantage of the knowledge of the traditional fishermen. Similarly, intensive extension services should be provided for the fishermen.

5. Initiate scientific investigations to establish the causes of the decrease of the popular fish species, such as, Tilapia esculenta, Labeo, Barbus and Propterus. The studies should assess the negative impacts, if any, of the presence of the commercially attractive but predatory Lates nilotica (Mbuta). The scientific views so far available are far from conclusive.

6. Studies should be carried out to establish if certain species, e.g. propterus (Kamongo) in the Lake, are endangered species, and protective measures implemented.

7. Aquaculture is presently being practised at artisanal/ subsistance level. There is, however, considerable potential for further development of fish culture in the region. It is urgently recommended that fish farming be promoted to a fully commercial status in the basin area.

8. Explore the possibility of establishing cage fish culture for tilapia within the Lake which may benefit from the otherwise plentiful planktons.

9. Conduct Studies to ascertain feasibility of establishing fish-meal-industry for both human consumption and poultry feed. It should be cautioned, however, that fish, as it is, serve well for human consumption and mealing might not be necessary. On the other hand mealing for poultry or animal feed might be contrary to nutritional interests of the local population.

10. The Cooperation of Tanzania and Ugandan authorities should be sought for the coordinated management and development of fisheries resources of Lake Victoria Basin. The Authority should liaise with the Ministry of Foreign Affairs and the Department of Fisheries for a negotiation of a comprehensive framework.

B. FORESTRY

1. The prices of imported fossil fuels are continuously escalating and Kenya being a non-producer feels the pinch inspite of heavy reliance - almost to the tune of 80% _____ on wood fuel and charcoal for her energy requirements. With the increasing population there is every danger of deforestation which threatens ecological balance. This necessitates urgent intervention through conservation measures as well as of forestation techniques.

2. With increasing industrialisation Kenya needs increased local production of timber, pulp and paper. This calls for an increase in the development and planned exploitation of forest resources.

3. The Lake Basin contributes only 25% of the current total national forests area with a preponderance of these within river catchments. The forests act as a conservatory mechanism for ecological balance by controlling of soil erosion and run-offs, and also form the basis of water supply as well as contributing to soil fertility.

4. It is imperative that government efforts at reforestation and afforestation be reinforced within the region with particular focus on rocky and hill-top lands. Nurseries that provide free information and seedlings to the local populace must be expanded.

5. Whereas fast-growing exotic tree species should be promoted particular attention ought to be paid to the danger of damage to the soil by the same through excessive absorption of nutrients out of the soil. There is need to employ or co-op the services of silviculturists, foresters and supporting personnel.

6. In ensuring widespread implementation of these goals, it may be in order to review the present land tenure structures with a view to providing for communal block forest development.

7. With increase in livestock development agro-forestry is required especially in dry areas to increase fodder for the animals, shade and windbreak, as well as to promote soil conservation.

8. In the tobacco growing areas, the appropriate trees should be grown to provide firewood for tobacco curing.

C. GAME

1. The tourist industry in the Lake Basin is relatively undeveloped compared to other areas in the country. Game, being the central tourist commodity is relatively undiversified except in the peripheral Maasai Mara. There is need therefore to diversify and increase game in reserves such as Lambwe Valley, Mt. Elgon, Homa, Saiwa Swamp and Cherangani. The Forest Reserve at Kakamega could be more attractive with injection of such animals as monkeys.

2. The Basin has unique bird species particularly in Kakamega, and Nandi forests which should be given more publicity. Small scale sanctuaries exist at Simbi and Ondago with high potentials and should be developed.

3. The increasing interest in use of land for game and forestry for tourist industry should not be allowed to undermine the use of land for agricultural purposes especially in areas where land is scarce.

4. Apart from the need to diversify wildlife, other infrastructure need urgent development in order to support tourism. These include good all weather roads, good hotels and lodges within reasonable reach of or even within the reserves and Parks; development of sporting facilities including yatching on the Lake, golf and other sports.

5. The core Lake basin has no single game warden and there is need therefore to post warden(s) and other supportive personnel.

POLICY RECOMMENDATIONS ON "INSTITUTIONAL FRAMEWORK"

In view of the definition of Lake Basin as the catchment area and Nyanza and Western provinces as the development area, the Basin will be, by and large, the subject of planning while the two provinces will be the focus of both planning and development activity. It is recommended that the Lake Basin Development Authority (LBDA) should adopt a comprehensive integrated regional development planning approach and work to sustain and accelerate the stated objectives.

The structure that has been adopted for the Lake Victoria Basin Development Authority will enable it to serve both as an executive and a liaison authority. Where there are existing institutions the Authority will provide liaison to ensure effective implementation, but it has to develop the capacity to identify gaps, design and implement necessary programmes. To that end the Authority should be action oriented and avoid unnecessary bureaucratic red tape. The Authority should effectively use its executive and liaison powers. This will enable it to engage in immediate and long-term planning to ensure some modicum of permanency of development of the Lake Basin.

For effective and efficient functioning of the Authority it is recommended that:

1. The Authority should effectively use its powers to negotiate for funds from local and external sources for its capital development for the benefit of the area. It should also explore ways of generating its own funds.

2. There is an urgent need to examine the relationship between the Authority, parastatal bodies, private agencies and local authorities in the Basin area with a view to streamlining the relationship. The purpose will be to establish the necessary and effective working relationships between the Authority and such institutions, in the interest of development.

3. District Development Committees operating in the development area should be responsible to the Authority. This will enable the Authority to follow up the implementation process of the approved development projects and to take plan for coverage of underdeveloped areas.

4. In each sector the Authority should establish "development units", each headed by a specialist in the respective field. As necessary, advisory committees can be established for each sector. The specialized sectors should include, inter alia, public health, education; hydrology and water engineering; economist, ecologist; resource law; cooperatives and finance; soil science, agronomy; survey and physical planning; animal husbandary; geology and minerology and forestry.

5. In its activities the Authority should be action-oriented and to steer clear of self-centred and parochial political interests.

6. In its development efforts the Authority should have a clear bias toward involving the local population by encouraging local grassroot participation in the development process. This provides the proper environment for planning, implementation and continuity of the development programmes.

7. Without the proper cooperation and common understanding provincial administration can be frustrating to the development process due to witting and/or unwitting power struggles. It is therefore imperative that the Authority should develop close working relations and linkages with the Permanent Secretary in the Office of the President and the provincial administration in general.

3. In the interest of effective planning and implementation of development project, a direct link and good working relationship should be established between the principal officers of the Authority and their counterparts in the scheduled Ministries. Similarly, the

Managing Director of the Authority should develop working relationship with the Permanent Secretaries in the scheduled Ministries.